ANTHOLOGICA AQUATICA

A Collection of Aquarium Articles by Albert J. Klee

VOLUME II

Dedicated to the members of the Aquarium Hobby History Society.

(http://groups.yahoo.com/group/AquariumHobbyHistoricalSociety)

In all of the history of a pastime,
There's nothing greater than sharing a history.
Roots that reach back into yesteryears
Have grown entwined through laughter and tears
Are stronger than any new growth.
And while beginning anew may seem enticingly appealing
There's no better feeling
Than the closeness of an old, familiar love,
A love of history.†

Layout and design by Albert J. Klee

†Based upon a poem by Arthur Wallace

ANTHOLOGICA AQUATICA

VOLUME II

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Which Species Are The Hardest To Breed, Spawning of *Xenocara*, Breeding Medakas

[Aquarium Journal, September 1959]

A common topic of conversation whenever aquarists congregate is, “Which species of aquarium fishes are hardest to breed?” There are many species which are on record as not yet bred in the home aquarium; archerfish, scats, *Monodactylus* and species of *Leporinus*, for example. Of those that have been so bred, many are considered difficult breeders by all hobbyists. In this group can be counted the rummynose tetra (*Hemigrammus rhodostomus*), *Hyphessobrycon rosaceus, Phenacogrammus interruptus*, discus, and *Loricaria*. Our British friends, however, consider a number of fishes in this “difficult-to-breed” group that Americans do not ordinarily think of placing there. Such species are: glowlight tetras (*Hemigrammus erythozonus*) lyretail (*Aphyosemion australe*), *Aphyosemion bivittatum*, *Pelmatochromis kribensis* and *Apistogramma agassizi*, to name but a few. It is difficult to fully explain this difference of opinion. It has been noted, however, that American aquarists are more highly interested in killifishes (“panchax”) and dwarf cichlids in contrast to their British aquarists. This is apparent in the relative number of times articles devoted to these fishes appear in their respective national aquarium magazines.

The amount of tank space allotted a particular species of fish is not necessarily dependent upon the size of the fish. This is especially true when dealing with fishes possessing auxiliary breathing apparatus, brackish water fishes, and fast-moving schooling fishes. Schooling fishes, such as danios, need more swimming space than is customary for their size. So do brackish-water fishes such as *Monodactylus*. The air-breathers, on the other hand, can be quite crowded with no ill effects. I have an 8-gallon aquarium in my home containing a pair of climbing perches that are 6 to 7 inches long, respectively. As a tank mate, the aquarium contains a 12-inch American eel. The eel originally came to me from the Atlantic Coast off Boston and subsequently adapted to freshwater. The biggest problem with these fishes centers about turning around in this small tank. All are well suited to waters of low oxygen content, however, and do quite nicely together. If, instead, these fishes were angelfish of comparable size, this amount of crowding would be disastrous.

Aquarists have been waiting for many years for the first person to spawn a catfish of the genus *Plecostomus*. For all practical purposes, the wait is over for a very near relative, *Xenocara dolichoptera*, has been spawned by a German aquarist. *Xenocara* has been seen quite frequently in American aquaria and is usually mistaken for some species of *Plecostomus*. The breeding took place in a 10-gallon tank under the following conditions: pH - 6.5, D.H. - 7, temperature - 75° F. The male *Xenocara* was easily sexed, as it possessed chin whiskers and a triangular shaped head. The female had practically no whiskers and her head had the shape of a 32 hexagon. In size, the male appeared to be between 5 and 6 inches long, the female between 3-12 and 4-12 inches. Briefly, the tank contained gravel, stones, and a tree root. The pair dug a depression in the gravel and uncovered the bottom of the tank.

The actual spawning was not witnessed but about 40 young, each 1/3 of an inch long, appeared 2 weeks after the hole was dug. The adults were fed lettuce, tubifex worms and dry foods while the fry were started on the natural algae present in the tank and, a few days later, on lettuce leaves. In 7 weeks, the fry were between 3/4 and 1 inch long, and in 6 months they reached 1-12 inches.

For beginners who wish to breed an egg layer, I heartily endorse the medaka (*Oryzias latipes*). These fishes are killifishes but breed in an unusual manner. At intervals of a few days to a week, clusters of eggs are seen hanging down from the female's vent. Being adhesive, the eggs stick to plants, wood, stone, etc., as the fish brushes by. The eggs are very resistant to fungus and a large percentage hatch. Furthermore, the fry are easily raised on newly hatched brine shrimp, strained baby foods, or microworms; no infusoria is necessary. The adults are able to withstand temperatures in the 40's and are peaceful community tank fishes. They do not require a large aquarium either, for a 1-gallon jug will house a breeding pair. Sexing, too, is relatively simple. The anal fin of the male is larger and has a straight outer margin. The female's anal fin is smaller and the outer edge is concave. Other differences such as body shape and size, size of the dorsal fin, etc., also make sexing obvious.

Aquarists interested in the Australian fish scene were saddened at the recent demise of that fine publication, The AUSTRALIAN AQUA LIFE. I am happy to report, however, that a notable substitute is now at hand with the expansion of publication of the Victoria Aquarium Society's FINCHAT. The May issue contains 36 pages and the printing is very, very good. The magazine contains well-written articles mostly devoted to beginners but with a number devoted to the Australian fish scene. To those desiring to subscribe to this excellent little magazine, such subscriptions should be sent to:

C. Davis
104 Eskdale Road
Caulfield, Victoria, Australia

Payment is 28 Australian shillings ($3.08 in our money) for a 1-year postpaid subscription and should be made out to The Aquarium Society of Victoria.

Xenocara, Tank Background

[Aquarium Journal, October 1959]

In my last column, I described the first breeding of the blue or spotted Plecostomus, more correctly known as *Xenocara dolichoptera.* Surprisingly enough, Mr. Walter Armbrust of Hamburg, Germany, has announced that he also has spawned this sucker mouth catfish. A number of spawnings were made by Mr. Armbrust's fish, the first in an aquarium 20 inches long and subsequent spawnings in an aquarium only 12 inches long. The breeders themselves were about 4 inches in length. The breeding aquaria were supplied with 34-inch diameter bamboo sticks and the water used was tap water from Hamburg mains with a reading of about 15 DH (degrees of hardness, in this case, rather hard water). The spawning actions resembled those of species of *Loricaria* except that less care was taken with the placing of the eggs by *Xenocara* than is usually observed by *Loricaria.* The adhesive eggs were fastened to bamboo rods in clumps and were cared for by the male fish. Mr. Armbrust used one male to two females and since each female laid about 60 to 80 eggs, each spawning resulted in approximately 100 or more young *Xenocara.* Those young unable to suck soon after birth, died shortly afterwards, Otherwise the number of young raised to maturity per spawning would have been closer to 120-160. The incubation time for the eggs proved to be 6 days and another 3 to 4 days for the egg sacs to be absorbed. Apparently the eggs are not sensitive and the young are easy to rear. It is interesting to note that according to Mr. Armbrust's experience, the "breeding cycle" in the aquarium of the parent fish is about 6 to 8 weeks. That is, his fish rested this period before spawning again. With these successes in mind, the question is, "Who will be the first to spawn the common *Plecostomus?"* The question is not just idle curiosity either, for several South American countries have placed embargoes upon the export of this fish, and it could happen that, without successful aquarium spawnings, this fish could become extremely rare indeed.

For years, I have been looking for the solution to the problem of providing a suitable background for display tanks. Many things have been tried; displays behind the rear glass, rockwork within the tank and built up along the rear glass, etc. Although not a perfect solution, I do offer a suggestion that has worked for me and has been received very favorably by visitors to my fishrooms. There are available nowadays, sheets of more or less rigid plastic materials pressed into shapes of natural stone and brick. Although the material itself is only about a 1/32 of an inch thick, the molding process produces a sheet with a nominal thickness of approximately 34 of an inch. These sheets are easily cut to fit the inside of the aquarium, either along the rear glass or the rear glass plus the sides, depending upon how many viewing sides are desired. The sheets are cemented to the glass with asphaltum varnish. I have found the stone design particularly attractive in the aquarium and although the sheets are available in either pure white or in natural colors, I prefer to purchase the white sheets and paint them with the black asphaltum varnish. The effect is quite startling as, being inside the tank, no part of the frame shows. In addition, the stone texture is perfectly in accord with the fishes and plants. In time, the asphaltum varnish encourages the growth of algae upon itself, further enhancing its appearance. The plastic sheets are harmless to fish and plants as is the asphaltum varnish. In time, the sheets may come unstuck from the glass but if they are cut slightly oversize and wedged into place, there is no need to use the asphaltum varnish at all except for painting the sheet if taste so dictates. If you have never seen these plastic sheets and would like to get an idea of what they look like, check the Sears, Roebuck catalog. They are called Harmony House 3-D Plastic Wall Panels and cost about 20¢ a square foot.

Color Factors in Bettas, An Odd Filter

[Aquarium Journal, November 1959]

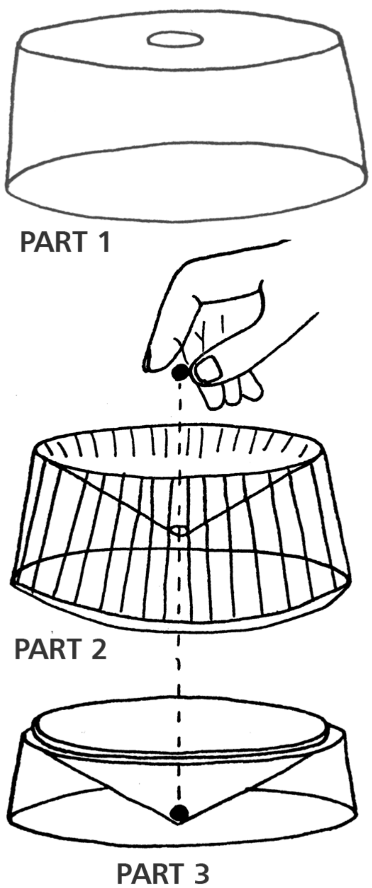
A very interesting observation about color factors in the *Betta* has been advanced by Dr. Gerd Meyburg recently. Dr. Meyburg recognizes five color forms as follows:

1. Flesh color (as in Cambodia Bettas)
2. Red
3. Blue
4. Green
5. Brownish-black
6.

The theory states that the color factor and the vitality of the Betta variety are correlated. "Vitality," as used here, not only relates to the temperament of the individual fish but includes ease of reproduction and the strength of the fry as well. According to Dr. Meyburg, vitality increases as one proceeds from red to blue to green. In other words, the green Betta is the strongest of the strains. On the other hand, both an overabundance of color (black Bettas) and a deficiency of color (flesh-colored Bettas) result in reduced vitality. It has been observed that flesh-colored Bettas reproduce normally but suffer high fry mortality. Black Bettas, however, are subject to melanomas (tumors containing a dark pigment). When breeding Bettas, distinct color changes occur. Body color darkens and a series of dark, oblique lines appear on the sides of the fish. These changes are stronger in green and blue Bettas, and weaker in red Bettas. Flesh-colored

Bettas do not show any stripes but the whole body does darken. Dr. Meyburg's observations remain to be verified or refuted by American Betta breeders, and they should serve as an interesting topic of discussion.

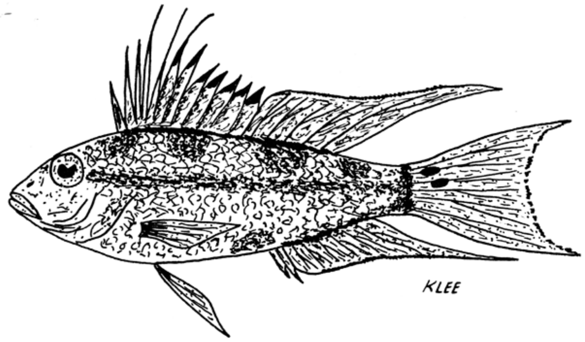
A peculiar (at least by American standards!) filter has just been placed on the German aquarium market. The new devise certainly carries "biological" filtration to its extreme. This article of aquarium equipment is constructed of plastic in three parts, only two of which remain in continual use. Part 1 contains a cone-like structure and is placed in the aquarium gravel up to its top rim. Part 2, another cone-like structure but with slots cut into its sides, is placed upon Part 1. An oxidizing pellet containing a chemical substance that is claimed to oxidize mulm and other aquarium debris into harmless material is dropped into the device. The pellet falls into the lower part of the apparatus. The whole device is placed in the lowest part of the aquarium where it receives mulm through the water currents set up by movements of the fish and/or aeration. Once the mulm is received, it is oxidized. When completely full of mulm, Part 3 (a cap) is slipped over Part 2 and the device removed for cleaning. The manufacturer likens the apparatus through analogy to a gardener raking leaves and forming a compost heap. I don't quite know whether to laugh or be impressed but at the very least, one must admire the inventor for his ingenuity!



Gourami "Feelers," *Apistogramma cacatuoides*, *Cryptocoryne* Disease

[Aquarium Journal, December 1959]

Few aquarists take the trouble to verify or refute long-held ideas of the hobby. For example, it has often been explained that the elongated ventral fins (feelers) of a Gourami are used by the fish as organs of touch whereby the fish uses them to feel his way about an uncertain environment. To investigate this, one hobbyist placed a clear plastic cylinder in an aquarium, the bottom of which was imbedded in the gravel while the top projected above the water surface. A hole was cut in the side of the cylinder somewhat above its middle. This contraption was difficult to see when immersed in water. A number of blue gouramis were then placed in the cylinder. Those fish that placed their feelers upon the cylinder did not leave even when their feelers poked through the hole. Only when the fish found the opening with their mouths, did they leave. Many of the gouramis did not use their feelers and they also left only when their mouths touched the opening. This hobbyist concluded that the feelers of gouramis are not primarily used for determining position or objects in general, but rather are used as organs for food searching. This hobbyist did not prove that these fish detect food with their "feelers." He only observed



***Apistogramma cacatuoides* Hoedeman, as drawn by Albert J. Klee**

that they do not detect holes in clear plastic cylinders with them. However, this is a good start and more experiments would be interesting.

A few months ago, a fellow aquarist brought me two specimens of a dwarf cichlid. At first glance (see figure), they appeared to be what I have always called, *Apistogramma* "U-2," however, they were more bluish (U-2's are decidedly yellowish) and had one or two burnt-orange spots in the base of their tail fins. The dorsal fin was very similar to that of the "U-2." Unfortunately, the two fish were males and I could not attempt breeding them. They proved to be very amicable in a community aquarium. Recently, I discovered the fish I had were *Apistogramma cacatuoides* Hoedeman. The specific name is derived from the word, cockatoo, and fairly well describes a fish whose fins resemble plumage. Since the cockatoo cichlid is reportedly not too difficult to breed, it should become popular with dwarf cichlid fanciers together with those aquarists desiring a peaceful cichlid for a community aquarium.

It has long been known that most species of *Cryptocoryne,* although managing to exist under hard, alkaline water conditions, do much better when the aquarium water is soft and slightly acid, Many aquarists experience trouble with their Cryptocorynes and even have referred to unexplained disorders as "Cryptocoryne disease." It appears now that excessive lighting may be one cause of this trouble. In an experiment by Arno Hiller using a 30-gallon aquarium containing Crypts, the amount of artificial (incandescent) light supplied to the aquarium was varied. The normal lighting was two 25-watt bulbs, 12 hours daily and the aquarium water at the start tested pH 6, DH 3° and also contained a peat extract. The following in Table I was observed:

This experiment dramatically underscores the need for the proper amount of illumination when using Cryptocoryne species in the aquarium.

TABLE I

AMOUNT OF LIGHT	CONDITION OF PLANTS
50 watts, 12 hours/day (normal)	Healthy, good condition
80 watts, 16 hours/day	Leaves lost dark green coloration
100 watts, 16 hours/day	Leaves turned light green and yellow flecks appeared upon leaves. After fourteen days, tip of plants became translucent (glassy).
120 watts, 16 hours/day	After one day, 2/3 of the leaves became glassy and after 2 days, the plants completely disintegrated. The aquarium became clouded with decomposition products.

Nothobranchius Water Analysis, Microworms and Beer, Spawning *Loricaria*

[Aquarium Journal, February 1960]

Frequently, aquarists lack the necessary information concerning the water conditions under which fish are found in nature. Without this information they experiment differently in breeding some of the more difficult species. In the case of the annual killifishes of the genus Nothobranchius, Dr. Walter Foersch supplies part of this valuable data. The following is an analysis of the water in which a number of *Nothobranchius* species were found:

pH - 7.1
Temporary hardness - 6.1 DH
Total hardness - 8.3 DH
Chloride - 61 mg/l
Nitrate - 27 mg/l
Iron (total) -11 mg/l
Silicate (as SiO_2) -11 mg/l
(See Table I for rainfall and temperatures.)

One aquarist reports much success in the use of beer in raising microworms. The beer replaces the usual cereal, yeast substrate used by most aquarists. Beer microworm cultures are favored by some since the culture never becomes stale or smelly if properly prepared. Most hobbyists are familiar with the range of odors that are produced by two and three-week old microworm cultures and know that these mixtures put rotten eggs into the category of afternoon teas. The beer to be used must first be aged a few days by allowing it to sit out in the open, the well-known "stale beer." A container having a convex bottom (a hump in the middle) is also necessary. Enough beer is added to cover the bottom but still leave the hump free. A quantity of microworms is added to the hump. In a few days to a week, new worms will be seen covering the hump and a great deal of the sides of the container. Such mixtures can be kept for months, often up to a full year without anything more than adding beer occasionally to keep the bottom moist. Actually, beer is excellent food for microworms and, surprisingly enough, it contains a full range of nutrients necessary for the production of a live fish food. When buying the beer, however, don't mention the purpose - the management might start measuring you for a straitjacket!

The breeding of *Loricaria parva* (or perhaps another of the many species of *Loricaria*) has been reported in American aquarium literature only a few times yet this fish has actually been bred quite frequently in the past few years. In this species, the male guards the eggs much like the typical cichlid. Unfortunately, much also like the typical cichlid in the aquarium, the male is prone to eat the eggs. Since the av-

TABLE 1

	DAR ES SALAAM	BEIRA
Yearly rainfall	46.4 inches	55.5 inches
Month of most rainfall	April (12 inches)	January (10 inches)
Month of least rainfall (dry period)	May-October (from June to August about 1.1 inches)	June-October (from June to September about 0.6 to 1.3 inches)
Average air temperature	78° F	78° F
Highest air temperature	82° F (February)	81° F (November-December)
Lowest average air temperature	75° F (July-September)	72° F (July)

erage spawning of *Loricaria* consists of 40 to 50 eggs, it doesn't take much time for the parent fish to consume them. It must be said that part of this caviar-consuming behavior is due to the fact that many spawns are not fertilized properly. One of the problems, therefore, is to obtain a male willing to fulfill all of his obligations. This may be quite difficult, however, and experience has indicated that the greater percentage of a spawn will turn out to be females, frequently as high as 100%. What causes this is not known, the same problem being prevalent in the breeding of many killifishes.

Scat Habitat Data, Residual Plastic Dangers

[Aquarium Journal, March 1960]

From Australia (via the magazine FIN-CHAT) comes an interesting item concerning scats. Seems a group of aquarists out on a field trip found a number of scats in a water hole. The water hole was actually part of a creek, which, due to the dryness of the season, formed a series of unconnected pools of water. The local aquarists informed the field trip group that the scats were between 10 and 11 months old, and also that the creek hadn't flowed for 12 months. If both bits of information were correct, then it must be concluded that the Scats were spawned in the same hole in which they were found. In view of this possibility, the Australian aquarist group had the water analyzed with the following results: pH - 8.3, degrees of French hardness, 2.1 (this is equivalent to 1.17 degrees of German hardness or 21 ppm in customary U.S. measure), total solids - 195 ppm which further breaks down into 174 ppm of NaCl plus 21 ppm $CaCO_3$. Additional information supplied by the field trip group noted that the air temperature was 80° F. and the water temperature was 74° F. This water in which the scats were found is, in some respects, almost fresh water. However, it certainly is quite alkaline.

Sometimes useful information comes to aquarists from the most unusual sources. From the laboratories of the Rockefeller Institute for Medical Research a report was issued concerning the toxic effects of certain plastic sheets to fishes. For many aquarists, this is no problem as the commercial manufacturers of plastic aquarium equipment in this country use materials that are proved harmless to fish and plants. However, the do-it-yourself urge gets the best of us at times and aquarists are forever constructing dividers, hangers for heaters, gravel guards, etc., all out of plastic. The Rockefeller report experimented with cellulose acetate sheets, one of the most common plastic materials. Cellulose acetate itself is not toxic to either plants or fishes but the plasticizer commonly used, is. If the plasticizer is not present, the sheets are harmless. On the other hand, plastic sheets containing free plasticizer were found to be extremely toxic. Fish were exposed to this poison by confining them in water in a fish bowl in which small pieces of the plastic were immersed. They died within a few hours. The Rockefeller report was more precise, of course. For instance, 3 grams (a dime weighs about three grams) of plastic were placed into the water containing a 1-1/2 inch goldfish. The goldfish was dead in 45 minutes. 0.3 grams killed after 4-12 hours and one drop of the plasticizer killed within 30 minutes. Storage or soaking the sheets in water had little or no effect on the toxicity of the cellulose acetate. It was also pointed out that, since the plasticizer has a bitter taste, the toxic sheets could be distinguished from the harmless plastic by tasting the sheet. It is easy to discern the bitter taste of the toxic plastic sheets. The report concluded that small amounts of the plasticizer are toxic both to plants and fishes as is plastic cellulose acetate sheeting containing free amounts of plasticizer.

Russian Aquarists, Hatching Annual Killifishes

[Aquarium Journal, April 1960]

In the January issue of the very excellent Swedish aquarium magazine, AKVARIET, appeared an interesting article on the aquarium hobby in Russia. The article consisted of a series of questions posed by the staff to a leading Russian aquarist, Mr. M. Machlin of Leningrad. Apparently, the Russian aquarist is quite like his American counterpart as he seems to flavor his hobby with fewer scientific overtones than do most other European aquarists. Russian interest in the aquarium hobby centers in the large cities such as Moscow, Leningrad, Charkov, Rostov, Kiev, and Odessa. It started in 1856 and by the 1870's many aquarists were to be found. The first aquarium societies were started in 1899 in both Moscow and Petersburg (now Leningrad). The Leningrad aquarium club is quite impressive with a membership of about 800 and an average attendance of 300 aquarists. Last September, this club held a public exhibition in which 200 members participated, showing 89 fish species and 42 kinds of aquatic plants. The visitors to this affair totaled over 27,000.

Not too many species are available to the Russian aquarist on a continuing basis and about 10 to *15* species are usually available at all times. Typical prices for fishes are as follows (the ruble is worth about 25¢)*:* Young swordtails -*3* rubles, medium-sized adult swordtails - 5 rubles, 4 to *6* inch goldfish -*5* rubles and neon tetras, 15 to 24 rubles (ouch!). There are four aquarium stores in Moscow, three in Leningrad, and one in Riga. Added to this are many state-owned fish breeding establishments. To show the amount of fish bred in these establishments, the following is the production (total) of several species of fishes for the Moscow hatchery during the period 1932-1957:

Colisa lalia (dwarf gourami)	12,931
Barbs (all kinds)	30,937
Danios	53,089
Guppies	76,529
Goldfish (and varieties thereof)	292,290

One of the greatest problems facing breeders of the annual killifishes (in particular, species of *Nothobranchius, Cynolebias* and *Pterolebias)* lies in getting the eggs to hatch. A hatch, to really be termed successful, must also be relatively free of "belly sliders" or those fry unable to swim. A number of variables have been studied which have been suspected of being significant factors including temperature, light, water, oxygen content and the degree of

TABLE I

EXPERIMENTS WITH *NOTHOBRANCHIUS MELANOSPILUS*

Date	Disposition	Almost Dry	Very Moist
12-21-58	Hatched Eggs without apparent development	94 (114)	4 (183)
1-30-59	Hatched	15	48
3-14-59	Hatched Eggs without apparent development	43 (50)	14 (31)
4-3-59	Hatched	3	2
5-3-59	Hatched	2	7

drying of the eggs. In regard to the last factor, it has been demonstrated, again and again, that eggs, which are, stored very wet produce large numbers of belly sliders. Furthermore, the degree of drying is highly critical. The well-known German aquarist, Walter Foersch, has conducted a number of experiments that show that eggs that are stored almost dry, develop faster, and incur fewer losses. One of these experiments concerned 580 eggs collected during the period October 1 to 4, 1958, from a pair of *Nothobranchius melanospilus.* The eggs were divided into two lots of 290 each and stored in glasses containing peat. In one container, the peat was almost dry and in the other, the eggs were kept rather moist. It should be pointed out, however, that the eggs were not stored so moist that water drops would fall off the peat when handled. The data collected are shown in Table I.

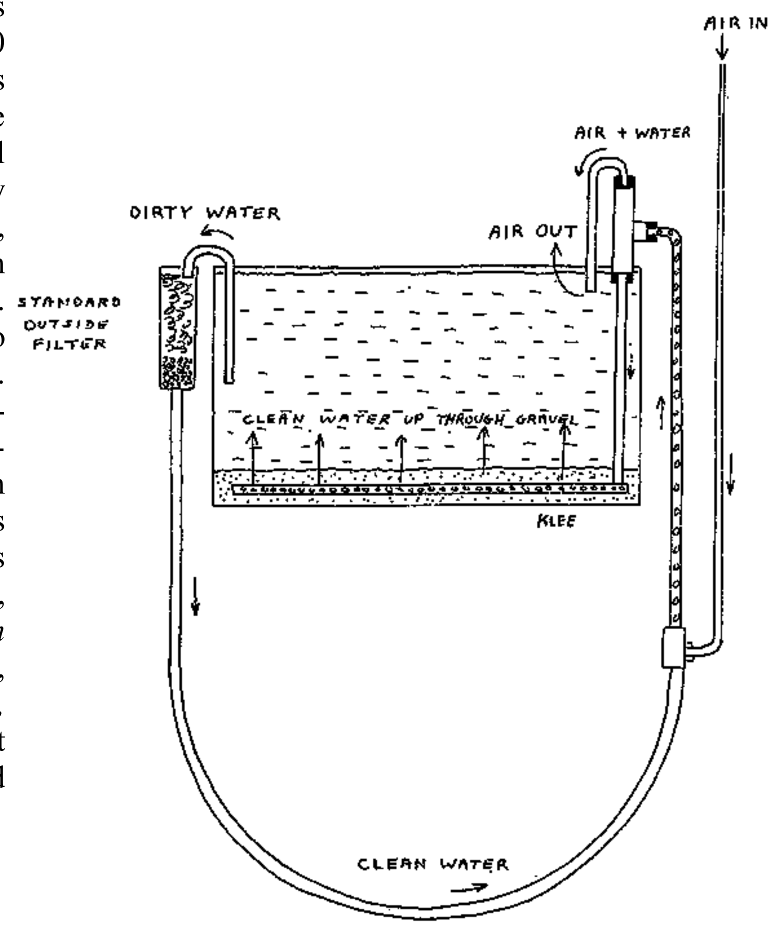
In the Table the discrepancies from the starting number of 290 eggs apiece are attributed to eggs that died during storage. All of the fry hatched out were normal swimmers except for 2 of the very moist stored eggs. In conclusion, almost-dry eggs seem to hatch faster and with fewer losses. Moist-stored eggs take longer to develop and fungus more readily. From other experiments, wet-stored eggs produced large numbers of belly sliders. Mr. Foersch found that bottom-laying species of *Aphyosemion* did not need this degree of dehydration; however, his experiences with *Aphyosemion sjoestedti* were limited. This fish, alone among the *Aphyosemions,* has a hatching time similar to that of the three genera described above.

An Improved Under-The-Gravel Filter

[Aquarium Journal, May 1960]

For the past few years, I have experimented with a novel filtration method that, up to now, I considered unique. To my surprise, a recent issue of DIE AQUARIEN UND TERRARIEN ZEITSCHRIFT (DATZ) contained a short article by Lotha Nestler describing a very similar device. However, Mr. Nestler's equipment is almost all custom-made while mine, for the most part, consists of "store bought'en" parts. In essence, the system to be described combines the excellent features of the rapid-filtration outside filter with a unique property of the under-the-gravel filter.

I do not wish to engage in any controversy over the outside filter vs. the bottom (under-



the-gravel) filter but it should be pointed out that outside filters are capable of removing great quantities of dirt from the aquarium within a short time while the bottom filter, if not overloaded, is capable of keeping black ravel from forming in addition to removing smaller amounts of aquarium debris. If the aquarist is careless, it is easy to overload a bottom filter, causing the gravel to pack tightly and thus restrict plant growth. If we consider only the problem of running the bottom filter to prevent gravel packing, then the answer is apparent - run the filter back wards! If clean, oxygenated water could be fed to the bottom filter, rising *up* through the gravel, then black gravel could be made harmless still (due to the well-oxygenated water rising up through it), without causing packing of the gravel. Of course, some other device would be needed to remove dirt from the aquarium. This is exactly what Mr. Nestler's and my device does.

Consulting the sketch, it is seen that aquarium water is cleaned in the ordinary manner via an outside filter. The water, instead of being returned to the top of the aquarium, is fed to the bottom filter via a down comer.

The only extra equipment needed is a "T" (made of glass or plastic) that separates the air from the clean water. The air bubbles out through the top layer of aquarium water, while the clean water flows by gravity to the bottom filter and up through the gravel. The air outlet also serves as an overflow for the water should the filter be operated at too great a rate. It is very, very simple and works like a charm. The size of the "T" (mine is made out of 1-inch diameter Plexiglas) will vary with the size of the outside filter, the size of the down comer to the bottom filter and the air rate to the outside filter. A little experimentation with "T" sizes should be all that is needed.

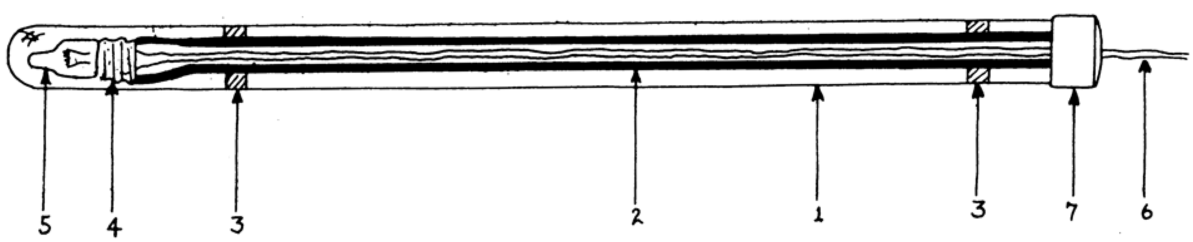
The water in aquaria so equipped remains clear, the gravel is sweet smelling, and the plants are fabulous growers. It appears that the plant roots are constantly being fed a nutrient solution from the bottom filter (the nutrients are dissolved in the "clean" water) and so are well nourished. If you like to tinker, here is a fertile field. Perhaps some manufacturer may become interested in the device and subsequently make them available to all aquarists.

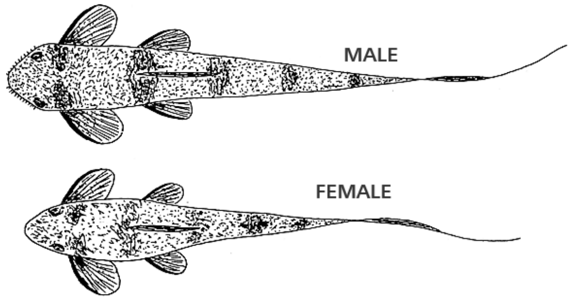
An Egg Finder, Breeding *Loricaria*

[Aquarium Journal, June 1960]

I have never taken the time to review the highly valued Dutch aquarium book, *Geschubde Exoten* (Scaled Exotics), in this column as few U. S. aquarists read Dutch. It is quite similar in philosophy, however, to that excellent translation of Tusche & Nachstedt's little book, *Breeding Aquarium Fishes* which, fortunately for, American aquarists not reading German, was published in English through the auspices of the Aquarium Stock Company. *Geschubde Exoten* has, however, over 300 pages and is to be considered the main course where *Breeding Aquarium Fishes* was only the appetizer. From time to time, I shall attempt to discuss some of the interesting ideas contained within this fine Dutch book.

EGG FINDER





One of these ideas comes under the heading of a do-it-yourself egg finder. As many aquarists know, it is frequently difficult to spot fish eggs in the aquarium, especially those hidden in thick pant growth. A lamp backlighting the aquarium is a help but suffers, from these three disadvantages: (1) it lights too great an area, (2) such a light is much too bright for some fish eggs and thus it can only be used for a relatively short time, and (3) it still misses many eggs in plant thickets and corners.

Author D. C. Oskam of *Geschubde Exoten* describes a simple piece of equipment that avoids these pitfalls and should be of real assistance. This is an "eierzoeker" or "egg seeker" and is pictured in the diagram: The numbers on the diagram are referenced as follows:

1. Glass test tube.
2. Narrow metal tube.
3. Bored rubber stoppers to hold the metal tube in place.
4. Lamp socket.
5. Lamp (3 volts, 0.3 amps) of the type used in pocket flashlights.
6. Plastic-coated wires to battery and switch.
2. Plastic cap sealed with a suitable cement to make the whole apparatus watertight.

Several requests have come to me asking for more information on the breeding of *Loricaria* catfishes, especially in. regard to sexing them. One of the early *Loricaria* breeders in this country, Mr. Carroll Friswold, points out that there is a definite difference in head shapes between male and female. The well-known German aquarist, Mr. Walter Foersch has also confirmed this. I have outlined these differences in the sketches. The fishes to be sexed must be, of course, full grown. It can be seen from the sketches that the head of the male is wider and is shaped almost like 2/3 of a hexagon. The female's head is narrower and forms a much more acute angle from the snout. In addition, the male usually possesses many bristles on his cheeks, on his head behind the eyes and on the first ray of his pectoral fins. These are not always present, however.

Sex Ratios and Temperature, Loach Spines

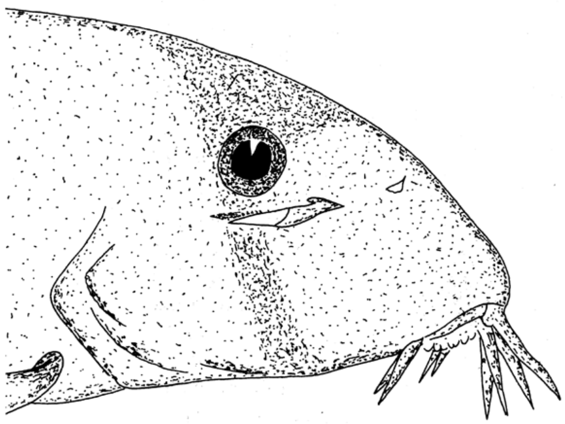
[Aquarium Journal, July 1960]

Recently, Mr. J. Wellner of Thuringen, Germany, postulated an interesting hypothesis concerning the effect of temperatures on the sex ratio (the number of males to females or vice versa) of aquarium fishes. The discussion was prompted by experiences with species of *Loricaria* in which broods are found to contain mostly females. Since Loricaria were thought by Mr. Wellner to be found usually in cool, swiftly moving mountain streams, it was suggested that breeding temperatures used were too high, thus causing an overabundance of females. Mr. Wellner's experiences were as follows:

1. A spawn of paradise fish *(Macropodus opercularis)* bred at 72° F, resulted in almost all males.

2. A spawn of Bettas *(Betta splendens)* bred at 75° F, resulted in 80% females.

3. Out of a spawn numbering 450 fry of the zebra Danio *(Brachydanio rerio),* only 10 males were found. The breeding temperature was 82° F.



Many loaches have a small thorn or spine below the eye, as shown in this sketch by Albert J. Klee.

4. During the particularly hot summer (in Germany) of 1958, breeding experiences with an annual fish *(Cynolebias (Cynopoecilus) ladigesi)* resulted in 98% females. The eggs were stored during the "drying period" at temperatures of from 82 to 86° F. During the winter, this ratio was about 50/50, the eggs being stored at about 75° F.

5. Breeding experiences with the dwarf cichlids, *Apistogramma reitzigi* and *Apistogramma agassizi* during the summer months at temperatures of from 82 to 86° F, always resulted in a 50/50 sex ratio. During the winter, at temperatures of from 72 to 75° F, males predominated.

6. The cockatoo cichlid *(Apistogramma* species), bred several times at 79° F, resulting in mostly males.

If there is something to Mr. Wellner's theory, then several interesting questions arise, one of which concerns the specific effect on sex ratio that temperature exerts. For example, in dwarf cichlids, does a low temperature always mean many males, or does it merely mean an unequal sex ratio with either males or females predominating? Mr. Wellner thinks the former is true and suggests that the optimum breeding temperature for the cockatoo cichlid is somewhat higher than 79° F. Also, would the sex ratio for the zebra Danios been 50/50 had the breeding temperature been lowered? Or raised in the case of the Betta? Here is a fertile field for experimentation. If temperature has an effect how does it exert its influence? Does its selectivity kill male or female sex cells? If any reader has data bearing upon this interesting question, I would be happy to hear from him.

German aquarists refer to their Loaches as, "Dornaugen," which means, "thorn-eye." There is method to this apparent madness, however, as many loaches do have a small thorn or spine below the eye. This thorn or better, spine, is kept in a groove but can be extended. At times, the spine manages to get entangled in the collector's net and some severe shaking must be done to loosen the fish. It is only fair to point out that the spine is not dangerous to aquarists and, indeed, it is not quite known what the real purpose of this projection is.* The sketch shows the spine as it appears in a clown loath. Many loathes do have the spine but some do not and an example of one which does not carry a spine is *Nemacheilus,* a typical example of which is *Nemacheilus fasciatus.* On most other loaches, a patient disposition and a strong magnifying glass are all that is needed to view this peculiar movable appendage first hand.

***One explanation forwarded is that the thorn or spine protects the eye when the fish burrows into the mud of its original habitat.**

Common Name for Killifishes, Effect of Zinc on Discus

[Aquarium Journal, August 1960]

In the April issue of the Swedish aquarium magazine, AKVARIET, Ulf Hannerz makes a strong and reasonable plea for the abandonment of the terms, "egglaying tooth carps," and "panchax," in referring to aquarium members of the family Cyprinodontidae. Clearly, the first is excessively long and awkward as well as being somewhat dated in the matter of classification (the egglaying tooth carps have been split into 6 or 7 separate subfamilies for some time now, and the order to which they belong consist of several families) The term, "panchax," is definitely misleading and although there might be a basis for so referring to some species, there is scarcely good reason for including fishes in such genera as *Aphyosemion, Nothobranchius, Pterolebias.* At one time, *Panchax* was a valid scientific generic name and included present species of *Aplocheilus.* This term was abandoned for cyprinodonts by science about 20 years ago but retained by aquarists for some species and later indiscriminately applied to all of the egglaying-tooth carps by aquarists.

Mr. Hannerz possibly following a suggestion by Dr. Myers in 1955 suggests the use of the term, "killi," to replace others now in use. It would appear that the use of this term among foreign aquarists is fortunately expanding and receiving strong encouragement from killifish fanciers (Col. J. J. Scheel, the outstanding Danish specialist in killifishes, publishes a series of bulletins about these fishes called, "Killiletters"). Some time ago, Dr. George Myers suggested the use of the term, "gambusinos," for those livebearers of the family Poeciliidae. The designation has never caught on, as it should have since no hobbyist had used the term before. (The term has been used a few times in the AQUARIUM JOURNAL*).* "Killifish" is more fortunate - it already has the approval of and is used by many American aquarists. It is also a long established name for egglaying cyprinodont fishes, being established by Dr. Jordan about 60 years ago. If publishers of aquarium literature, as well as wholesalers printing price lists, will use the term more frequently, "killifish" could swiftly replace the antiquated, misleading, and highly unsatisfactory *nom de plume* of "panchax" when referring to the whole of the egglaying Cyprinodontidae.

The danger of using zinc-coated or galvanized containers to collect rainwater was dramatically brought out by Mr. Helmut Niemer of the aquarium society, NEON, in Grevenbroich, Germany. Mr. Niemer was in the habit of adding rainwater, collected in galvanized containers, to a large tank containing guppies and discus. As a consequence of such a container, the rainwater was later found to have a zinc content of 16 mg/l. His first inkling of trouble occurred when he observed that his guppies were exhibiting extended gills and were very shy. In addition, the discus stopped eating and also were shy. After one of the discus died, an analysis of the water was made with the following results:

zinc, 4 mg/l (milligram per liter); pH, 6.6; total hardness 7 DH (German degrees of hardness); temporary hardness 1.1 DH

Mr. Niemer observed that another tank containing Discus was doing well and upon investigation, was found to contain only 0.2 mg/l of zinc. Accordingly then, he devised the following experiment. Four, classes were set up each containing two guppies and the observations shown in Table I were made.

TABLE I		
CLASS	ZINC CONTENT, Mg/l	DEPORTMENT OF GUPPIES
1	0	Normal, all would eat
2	0.2	Normal, all would eat
3	4	Shy, all would eat
4	16	Shy, neither would eat

After three days, the guppies in class 4 showed inflamed gills; after five days, the gills stood out; after eight days, the breasts of the fish appeared to be as if they were tightly laced; after ten days, one guppy was swimming on its back and the other also demonstrated swimming difficulties. Of course, the effect of zinc on fishes will vary with the mineral content of the water, temperature and other factors, however, as little as 0.3 mg/l of zinc has been reported to be dangerous to fishes and Mr. Niemer's experiences and experiments again spotlight the danger of zinc in the aquarium.

German Pen Pals, Sex and Temperature, Substitute for Peat

[Aquarium Journal, September 1960]

Another interesting aspect of our hobby is corresponding with aquarists in foreign countries. Unfortunately, there exists the language barrier. If an aquarist can read a foreign language then the difficulty may not be too great as the foreign aquarist may be able to do likewise. In a recent exchange of correspondence with a number of East German aquarists, I came across four aquarists who are interested in corresponding with American aquarists. The first two are youths desirous of corresponding with aquarists in the 15-18 year old age group. You may write in English, but they will answer in German. The third is an adult (29 years old, married) and also understands English but writes in German. The fourth, adult, not *only* understands English but writes it as well. Their names and addresses, in order, are:

Guenther Arzt
Roderwisch 12
Germany (DDR)

Christian Friedel
Karl Marx Stadt
Strasse der Nationen 130
Germany (DDR)

Siegfried Hoefer
Leipzig W 32
Eythraer Strasse 26
Germany (DDR)

Eberhard Alt
Lalendorf/Krs.
Guestrow
Germany (DDR)

This would be an excellent aid in learning German and these correspondents would probably be happy to correct your letters if you wanted to write in German as well.

Aquarists have long argued the question of whether or not sex and aquarium fish mortality rates are correlated. Unfortunately, reliable data are hard to come by and the basis of discussion has rested mainly upon personal opinion, coupled with scattered, rather weak observations. In the matter of deaths caused by high

TABLE I

	Male		Female	
	Number	Percent	Number	Percent
Surviving	10	32	47	81
Dead	21	68	11	19

TABLE II

Temperature, °F	
100	No sex differential
99	50% higher time to death for females than for males (in other words, the females took longer to die)
97	No sex differential
95	No sex differential
93	Time to death for females - 5660 minutes; for males, 3400 minutes

temperatures, however, a recent accident in the Biology Department of Winthrop College (Rock Hill, South Carolina) provides aquarists with considerable, and in addition, very reliable data. The Department had en conducting work with guppies when, over a weekend, the temperature of the laboratory was accidentally raised. At the time of this discovery, temperatures of the aquaria ranged upwards to 106°F and about 150 adult guppies and many young died. In general, if both adult and young fish were present in the same aquarium, the young fish were almost all dead if any adults were. It was also found that, in one tank containing several large females as well as smaller ones, the smaller ones died and the larger ones survived. In general, these findings substantiate other aquarium experiences of this sort.

The most remarkable observation, however, was concerned with the differences in mortality of the adult guppies with sex. A statistically significant higher male mortality was found. In 14 aquaria containing both sexes, the pattern of survival shown in Table I was found.

Dr. Freeman of Winthrop College points out that these data agree with those of M. B. Gibson for temperatures of 99°F but not others. Miss Gibson obtained the results sown in Table II.

The sex ratio for the fish before the accident in the Carolina lab was 54 males per 100 females; after the accident, 21 males per 100 females. These data suggest that elevations of temperature such as occur in small, shallow, unshaded pools of natural water, may bring about significant changes in sex ratio of the population.

A possible substitute for peat and zeolite-type water softeners suggested by Gerhard Lueder recently, is lignite or brown coal. This material has been found to act as a natural acidifier and softening agent for aquarium water. Brown coal is actually an organic material halfway in state between peat and ordinary soft coal and is quite inexpensive in areas in which it can be obtained. It is cheaper than peat (it is used as a cheap fuel in certain parts of the U.S.) and it does not release quantities of sodium salts into the aquarium water in the manner of zeolite softeners. Some experimentation has been done to determine the best form of brown coal to use. In a concentration of 10 grams per liter, the changes shown in Table III were effected in tap water.

TABLE III

	pH	Hardness
Pulverized brown coal	5.25	8.8 DH
Gravel-sized brown coal	5.5	7.0 DH
Coarse lumps	7.0	12.5 DH
Plain tap water control	7.0	16.0 DH

TABLE IV

	pH	Hardness
Initial tank water	7.0	16.0 DH
3rd day	5.8	7.0 DH
5th day	6.0	6.2 DH
7th day	5.8	5.5 DH

TABLE V		
	PH	Hardness
Tap water, 7th day	7.0	16.0 DH
10th day	6.8	9.2 DH
12th day	6.5	7.5 DH
19th day	6.5	6.7 DH

From this, it appeared that gravel-sized (2-3 mm diameter) brown coal was the form to use. A two-gallon tank was then prepared with an inside filter containing 80 grams (10 grams per liter) of brown coal of M to 5 mm diameter granules. The circulation of water through this filter produced an acidification and softening reaction as follows:

On the 7th day, the tank was emptied and refilled with tap water to test the capacity of the brown coal. The filter was run for 12 more days and the results are shown in Table V.

These experiments clearly show that brown coal reduces the pH and softens aquarium water and, furthermore, the reaction can be controlled so that these reductions are reasonable and not dangerous to fishes. Like peat, the brown coal colors the water and subsequent breeding experiments using this water showed it to be excellent for use with certain killifishes, notably *Aphyosemion calabaricus, A. calliurum ahli* and *A. filamentosum.*

Leaving Fishes on Vacation, *Lamprologus leleupi*

[Aquarium Journal, October 1960]

Yesterday, my family and I returned from a two-week vacation spent in the New York-New Jersey area. Before we went, some of my friends were interested in how my collection of fishes was to be taken care of during our absence. The answer was simple -just leave them be! This we did and I am happy to report that not a single fish was lost. This is a procedure I have followed for some years now and with much success. I would rather have my fishes go without food for two weeks than have someone who is not familiar with aquarium fishes take “care” of them. Before we left, all tanks were cleaned and the fish population of various tanks were juggled around so that no aquarium could be considered crowded. One point more - all aquarium lights in my fish room are automatically controlled by an electric timer. This timer turns the lights on at 5 p. m. and off at 11 p.m. therefore, there was no problem with dying plants or excess algae during our absence. Since these timers are not expensive, it might be well to look into this idea before you go on your next vacation. Be certain, however, that your aquaria are clean and under populated before you leave. Also, take care that fishes placed together are friendly towards each other as there will be no one home to swab with mercurochrome while you are gone!

It might seem that European aquarists are first in receiving all the new fishes and that what is new to American aquarists is old hat to our foreign friends. Perhaps this is partly true in the case of Asian and African fishes, but it is frequently the other way around when it comes to South American fishes. During my visit to New York, we stopped in at the Fish Bowl in Irvington, New Jersey, and chatted with George Russell for a while. He told me that the celebrated German aquarist, Dr. Eduard Schmidt, visited at the Fish Bowl en route to giving his address before the annual convention of the International Federation of Aquarium Societies in Chicago. Dr. Schmidt would pause in front of a tank and exclaim, “Wunderbar!” then move on to the next and excitedly ask, “Vair you get zis fish?” A moment later there would be another “Wunderbar!” Dr. Schmidt was quite impressed with the number of species of fishes available to the American hobbyist. So, maybe the grass isn’t greener on the other side!

Waiting for me when we got back to Cincinnati was a pair (I hope) of the brilliant new African dwarf cichlid, *Lamprologus leleupi.* This is a fish destined to make its mark in the aquarium fish world if it can de distributed widely enough among aquarists. It is one of the few freshwater tropicals that has the color of the typical marine fish, in this case, a bright yellow with a bit of orange tinge. And let there be no mistake, this is not a weak yellow but a hue that would be expected of a coral fish. As a matter of fact, the head of the canary cichlid (as it is being called in this area) reminds me of the marine fish, the Spanish hogfish. The canary cichlid is from Lake Tanganyika although the first *Lamprologus* imported as an aquarium fish in the last few years, *L. congolensis,* comes from the Congo region. One other species has also appeared on the U.S. fish scene, the fish being *Lamprologus mocquardi,* but it is the canary cichlid that is sure to bring fame to the genus. My pair is now housed in a 15-gallon aquarium containing gravel and slate and needless to say, my fingers are crossed!

A Lionfish Sting, Temperature and Hatching of Annual Fish Eggs

[Aquarium Journal, November 1960]

In these days of recurrent interest in marine aquaria, flashy, spectacular specimens of saltwater aquarium fishes are much sought after. Although an expensive fish, it is not at all unusual to find isolated examples of the lionfish, *Pterois volitans,* in marine aquaria all over the country. Most enthusiasts are aware of the dangerous venom secreted by the lionfish in its dorsal fin mechanism but familiarity often breeds contempt, regard for safety is pooh-poohed and the results frequently are serious.

A number of reports of accidents with this fish and related species have turned up lately but the one reported by Mr. Andre Paccaud in the Swiss aquarium magazine, *Aquaria,* is detailed enough to be of interest to American marine aquarists.

Mr. Paccaud was arranging items in an aquarium containing a lionfish *(Pterois volitans),* when he suddenly perceived the fish quite close to his hand. As he startled and jerked his hand back, the fish became alarmed and a dorsal spine stuck his right index finger. Immediately, he felt a sharp pain and after letting the barely visible wound bleed a while, he treated it with a 2% solution of potassium permanganate. As he replaced the cover to the aquarium, the lionfish appeared to be in excellent condition (small consolation!). The puncture showed no change but now the pain spread from the hand up to the elbow and his arm was virtually paralyzed.

At this time, Mr. Paccaud consulted a doctor and the latter used the usual preventive measures against snakebite complications, viz.,

10cc Calcium Sandoz plus Sandosten (antihistamine)
1 anti-tetanus shot
1 strong dose of penicillin + Streptomycin.

Although the doctor wanted Mr. Peccaud to remain for observation, the latter went home. The next morning, the finger still hurt strongly but was neither swollen nor reddened. He had weak legs, a tendency to vomit and suffered some loss of equilibrium. The doctor administered another round of shots and found that Peccaud's blood pressure had dropped from 130 to 70. Mr. Pecoaud could rise to his feet but only weakly. After three days, the pain was gone but the weakness, vomiting, and loss of equilibrium persisted. Injections and doses of caffeine were repeated up to the 6th day. The caffeine treatments were continued up to the 20th day, A month later, he still felt weak and could not tolerate the least bit of alcohol (let that be a lesson to those who would be careless!). After 40 days, Mr. Paccaud had recovered fully. Need we say more about common sense and safe practices with dangerous fishes?

In past columns, we have discussed the effect of variations in temperature upon developing fish eggs. Much of the available information concerns the eggs of the killifishes, mainly because of the great interest aquarists have in these fishes and the fact that killie eggs undergo a relatively long development period, lending easily to aquarium experiments. One of the "greats" in 'the' aquarium killifish world is the noted German aquarist, Dr. Walter Foersch; we have mentioned his name often in the past.

In a recent letter, Dr. Foersch reports on his experiments with the eggs of the annual, *Pterolebias longipinnis,* 835 of them to be exact. After 6 weeks at temperatures ranging from 46 to 64° F, 504 of the eggs were still clear with no signs of embryo development. Six containers *were* prepared with damp peat moss and 75 eggs were placed into each of them. These containers were kept for varying periods of time in a refrigerator, temperatures ranging from 41 to 48° F. The results are shown in the accompanying table.

The remaining eggs from each batch hatched out sound fry. Originally, the experiments were performed as a byproduct of an argument over whether or not the natural habitat of *P. longipinnis* ranged farther southwards in South America (away from the equator) than is maintained by some. If so, the temperatures farther southward would be expected to be cooler *and* it might be possible that the eggs would be able to resist lower temperatures. These experiments show that the eggs indeed can withstand low temperatures for rather extended periods.

LENGTH OF TIME IN REFRIGERATOR	NO. OF EGGS GOING BAD
4 days	25
9 days	32
12 days	65
16 days	66
20 days	71
24 days	75

It appears that temperature might have an effect on the "belly slider" question, also. With annuals, the usual procedure is to keep the eggs for a period of weeks or months in only a slightly moist environment. At the end of this time, water is added and the young hatch out. Mr. J. Franz of Dresden divided such a batch of eggs of *Pterolebias longipinnis* into' two equal parts; on one half he poured water of 73° F. and on the other half, water at 63° F. The eggs hatched out into the warmer water produced many belly sliders while almost all of the cooler-hatched eggs were sound, swimming fry. But when this procedure was followed with the eggs of *Cynolebias ladigesi,* the results were reversed! It would appear that there is an optimum hatching temperature for each species or perhaps even for every pair of fish within a species. In any event, the effect of temperature is an extremely important factor along with pH, hardness, degree of wetting, bacteria population, and water depth in the hatching of the eggs of the annual fishes.

The following is an unofficial "Guess What?" contest open to readers of the AQUARIUM JOURNAL. It suffers from the fact that no prizes will be awarded but then there will be no entry blanks to fill out either.

"For use in an aquarium a plate having a substantially flat top, a substantially flat bottom having a plurality of fine openings leading from the top of said plate to said channels wherein particles are comminuted in their passage through said openings, and a siphon pipe connected to said communicating channels and extending through the top of said plate."

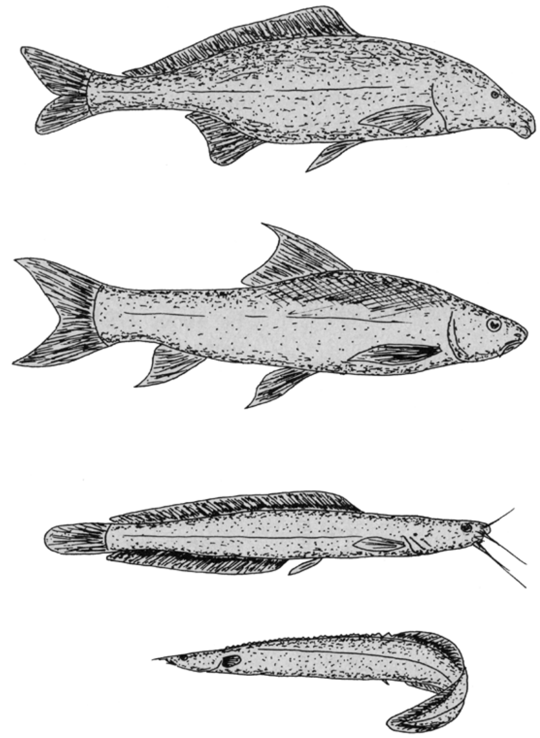
Give up? It is taken from a patent application issued to Albert J. Schwartz and Samuel H. Barbour on November 17, 1951 for an under-the-gravel filter! Aquarists who are of inventive mind are now forewarned that the difficult part may not be in the invention but the wording of the patent itself. Said author now signs off from said column for another said month!

Breeding the "Never Bred" African Fishes

[Aquarium Journal, December 1960]

Without a doubt, many experienced aquarists are always trying to breed the tough ones. The "never bred" appellation next to a fish's name unfortunately doesn't always suggest the long hours spent by aquarist after aquarist in attempting to breed some of these species.

A starting point for breeding such fishes would, of course, be some information concerning their natural habitat and, in particular, their breeding behavior in this natural habitat. With African fishes, our available information is somewhat more complete in the case of the killifishes and to a lesser extent, in the case of the cichlids. The natural breeding of such African fishes as spiny eels, elephant fishes, labeos, etc., is unknown to most aquarists. Limiting our discussion to non-cichlid fishes and also excluding the killies, science itself is somewhat deficient in its knowledge of the breeding habits of African fishes in the wild. In Lake Victoria, for example, the breeding sites for only a few such fishes are known: the African lungfish *(Protopterus aethiopicus) is* known to construct nests in the marginal swamps; the catfish, *Clarias mossambicus,* and *Labeo victorianus* spawn in temporary streams (resulting from heavy rainfall) that flow into the lake,



Sketches: From top to bottom: *Mormyrus kannume, Labeo victorianus, Clarias mossambicus*, and *Mastacembelus* species. Sketches by the author.

Both the lungfish and the catfish are kept by some aquarists, and relatives of the *Labeo* mentioned are also. I don't know how many aquarists ever try to breed these fishes, but such information is at least a starting point. One would, for instance, not be inclined to try spawning this lungfish in vigorously aerated aquaria.

A recent study by members of the East African Fisheries Research Organization (located at Jinja, Uganda), however, provides aquarists with information concerning other species. Two fishes in particular are involved: *Bagrus docmac,* a catfish, and *Mormyrus kannume,* an elephant fish. Based upon geological history, Lake Victoria in Africa has been colonized only relatively recently by fishes of swamps and rivers. At present, several non-cichlid fishes inhabiting the lake ascend the affluent rivers of the lake en masse to spawn. *Bagrus* and *Mormyrus,* however, do not. It must be assumed that they spawn in the lake itself.

The young of both species had formerly been known only from the effluent Victoria Nile (at Jinja) where they feed upon insects among the stones of the riverbed. Because of the torrential rains, the water here is a churning mass. Now in Lake Victoria itself, the only area resembling this region is in the vicinity of the shore where the shoreline is rocky. To test a theory, such an area was poisoned and the fishes so obtained were identified.

As was suspected, goodly numbers of young *Bagrus* and *Mormyrus* were found. It is certain now that *Bagrus* breeds along the exposed, rocky shores. The elephant fish, *Mormyrus kannume,* is still an open question but it appears likely that it too is a rocky-shore breeder. A surprising result was the great numbers of spiny eels also obtained *(Mastacembelus victoriae).* This agreed with that fact that another spiny eel *(Mastacembelus shiranus)* was found in numbers in Lake Nyassa only as a result of poisoning the rocky shores. A number of catfishes, *Clarias mossambicus,* were also found and it is significant that their known spawning sites (the temporary rivers) are also turbulent water regions. Unlike the *Bagrus* and *Mormyrus* the specimens of *Clarias* were too old to have been spawned on the rocky shore sampled and it is not intended to suggest that *Clarias* breeds there, also.

If turbulent waters are a prerequisite to spawning several of our rarer African fishes, the aquarists must be prepared to experiment with new techniques. Perhaps the "turbofilter" is needed here. In any event, it is certain that in breeding these fishes, hobbyists must go beyond the cut and dried standard methods of conditioning, isolating and juggling the water temperature. It is fashionable now to emphasize water quality such as pH, hardness, conductivity, etc., but we may be overlooking a good bet by ignoring some rather simple physical aspects of a fish's natural environment.

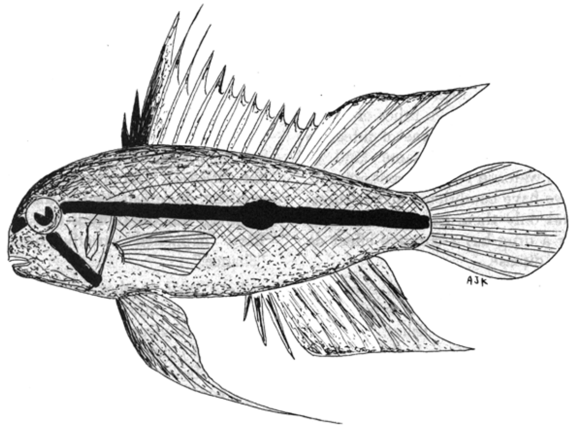
Spawning Soil Breeders in Charcoal, A New Species of *Procatopus* and *Apistogramma*

[Aquarium Journal, February 1961]

One of my "pen pals," Bruce Turner of New York City, has recently hit upon what appears to be an excellent medium for spawning the soil breeders. In Bruce's own words, "I have found a new medium for all soil breeders. It is fine enough to be easily sifted for eggs, will never foul the water and is dark enough to make the fishes feel at home. It has been right under my nose for a long time and I never thought of it as a spawning medium. By now, you must be dying to know what it is (Note: With a buildup like this, he was right!) so I'll tell you ... finely powdered bone charcoal. You should see the colors of a male *Aphyosemion filamentosum* against a solid black background - comparable to *Nothobranchius rachovii* and really startling compared against a light background as one usually sees them. The only trouble is that bone charcoal is slightly expensive in this area and that you lose a good third of it in the grinding process."

Those aquarists who read Jorgen Scheel's articles on *Procatopus* species in the Nov.-Dec. 1960 issues of the *Journal* will be interested to know that another species has been imported to add to the already-imported *Procatopus gracilis.* This new species is *Procatopus nototaenia,* brought in from Nigeria.

This species is somewhat bluer in coloration than the earlier species. As will be recalled from Col. Scheel's discussion, P. *nototaenia* is a member of the subgenus *Procatopus* while P. *gracilis* is a member of the subgenus *Andreasenius* and might be expected to differ somewhat in behavior.



Sketch: *Apistogramma trifasciatum haraldschultzi*, the subspecies described at the Zoologischen Staatsinstitut Hamburg, under, the direction of Dr. C. Kosswig.

Some time ago, Dr. Harald Schultz of the State Museum in Sao Paulo, Brazil, discovered a brilliant new dwarf cichlid. In the course of events, several of these fishes were shipped to Germany where they made quite a hit with dwarf cichlid fanciers. The fish has been tentatively identified as a new subspecies of an Apistogramma species first identified in 1903. This fish has been given the name, *Apistogramma trifasciatum haraldschultzi,* in honor of its discoverer. Since the nomenclature of the *Apistogramma* is on somewhat shaky ground, one should not become too attached to these scientific names ... one never knows when they may have to be changed!

The males of *trifasciatum* are a beautiful blue to blue-green, tending towards yellow in the ventral region. A short blackish to black line extends from the snout to the eye. From here the line breaks up into two lines, one dropping down onto the gill cover and the other extending back to the base of the tail. The dorsal fin of the male is colored a fire-red with the exceptions of the first few rays and the tips of all the rays ... these are solid black. The ventral fins are white to fire-red, and the coloration of the anal fin is similar to that of the dorsal except that the color is weaker. Finally the tail fin is yellow with a bright blue middle region.

Dr. Schultz collected this fish in the upper Guapore River in the Northern part of the State of Matto Grosso. He stated, "I found these animals in the thickest plant growths in shallow water with a depth of up to about 20 inches. They were plentiful and in company with many other species among those being *Aphyocharax, Megalamphodus,* a carmine-red *Hyphessobrycon* species, *Nannostomus, Poecilobrycon, Moenkhausia, Acestrorhynchus, Chilodus, Pyrrhulina, Leporinus, Anostomus* and many more, of which whose names I no longer recall. This is really a fish paradise! It yielded many cichlids such as *Geophagus jurapari, Aequidens curviceps* (? - perhaps a subspecies thereof), *Cichlasoma festivum* and *severum,* etc."

The fish has already been bred in water of 12 DH, therefore it seems that soft water is not necessary. This is one of those dwarf cichlids where the female guards the nest and fans the eggs, rather than the male. All in all, the breeding of this fish and the rearing of the young is no more difficult than is found with the familiar *Apistogramma agassizi.* This fish should be a welcome addition to our limited supply of dwarf cichlids.

Aphyosemion – Part I

[Aquarium Journal, May 1961]

After scanning the mountains of prose written about members of the popular killifishes genus, *Aphyosemion,* I came to the conclusion some time ago that several important aspects of these fishes were being neglected. As a result, I added a bit more to the mountain in the form of a series of articles in the JOURNAL (August, September and October 1960) entitled, "A Fresh Look at the Genus Aphyosemion." In spite of its length, this series was by no means a summary of the genus… it would have taken a small book to do that! Consequently, it was inevitable that the series should raise certain questions by readers. As a matter of fact, several areas of the series were designed to be provoking and frankly controversial (witness my argument for a rather restricted definition of the term, "annual") and the interest shown on the part of correspondents has been heartening, to say the least.

The following letter from Mr. John Gonzales of Philadelphia is one of the more searching and interesting received to date. I am of the opinion that his letter, together with some subsequent discussion, fills a rather large gap in my original series. Now to quote Mr. Gonzales:

"I have been a hobbyist since 1928 (except for a lapse of seven years from 1953 to 1960 when business temporarily precluded my continuing the hobby) and have always been partial to killifishes in general and the aphyosemions in particular. *Aphyosemion bivittatum* has always been one of my special favorites, and it is also one of the reasons why I am writing to you. I have had three different strains at three different times, and no two of them have been quite alike.

"The strain I had in 1934 had a delightful blue sheen . . . somewhat iridescent . . . across the upper part of the body. The area between the orange "wings" of the lyretail and the area between the orange border of the anal fin and the body were a bright blue-green, but definitely on the blue side. These, I imagine, were *bivittatum hollyi.* They were difficult to breed and had very small hatches. In 1951, I was fortunate in getting one of the first three pairs to be imported since long before the Second World War. These did *not* have any of the blue overtones on the body, and the areas that were blue in the tail and anal fin in the earlier strain were, in this instance, a vivid emerald green. They spawned readily and were quite prolific. These I assumed to be *bivittatum bivittatum* (at that time, of course, I did not know of the subspecies.

"Recently, I acquired a third lot of *bivittatum* that began spawning the day I brought them home and haven't stopped since. The body shape is typical *bivittatum* and both dark brown stripes are unbroken and fade and deepen at the fish's whim, against a golden tan body quite similar to the 1951 strain. However, they do *not* have lyre-shaped tails. Instead, the tail is shaped more like your illustration of *vexillifer (Journal,* September 1960) except that the point in the center extends further back beyond the upper and lower points. The dorsal is flecked with brown and reddish dots (as in 1951) and it is shaped like your figure 11 (loc. cit.).

The anal fin is also typically *bivittatum* with a thin transparent edge, a thin black line, and a wider orange band bordering it. The area between this border and the body, however, has neither the blue nor the green of the two earlier strains but is transparent. The tail has a repetition of the thin transparent - thin black - wider orange border, at the bottom and just the orange border at the top. The center area of the tail is also transparent. Is this just a poor strain of *bivittatum* or is it possibly another subspecies?

"My second reason for writing is for a clarification concerning *Aphyosemion calliurum.* In your article (loc. cit.) you describe A. *calliurum calliurum* as the yellow subspecies and A. c. *ahli* as the blue subspecies, which is the way I have understood the species to be divided. However, in DeLooze' article in the February (1961) issue of the JOURNAL he states:

'The body is a greenish-blue with a number of red dots; the fins including the tail are greenish. In A. *calliurum* these fins have a blue stripe at the end. These stripes in *calliurum ahli* are deep orange.'

"From one pair of *calliurum* I have been getting both of these color variations in the fins and tail as well as many degrees of variation in between. I have always considered them to be merely color variations within the subspecies, *ahli.* If I am wrong, please correct me. If I am not, then someone should correct Mr. DeLooze."

Mr. Gonzales raises questions concerning two species of *Aphyosemion* but essentially, the problem revolves about subspecies within the genus. Too little has been said about this in the past. Furthermore, an additional point is made about common names. This, too, has not received enough attention. If we can say something worthwhile about these two areas, perhaps then some contribution will have been made.

Aphyosemion bivittatum is an old aquarium fish. It dates back to 1908 in the hands of German aquarists. At that time and until the autumn of 1929, there was no problem with subspecies, as aquarists knew only one *bivittatum.* During this time, the fish was known as *Fundulus bivittatus,* although in 1928 this was changed to *Fundulopanchax bivittatus.* Came 1929, however, and another *bivittatum* was imported. The main difference between the established *bivittatum* and the newcomer lay in the decided bluish coloration of the latter. As a matter of fact, the very next year (1930), the new fish was named *Fundulopanchax bivittatum* var. *coerulea,* the coerulea, of course, signifying "blue."

Now there are two points to be made about *"F. b.* var. *coerulea":*

(1) This was not a bred variety … the fish was found in nature this way. Whereas the original *bivittatum* was on the record as coming from the Cameroons and the Niger delta, the "coerulea" variety was said to originate from some undisclosed source in equatorial West Africa… which wasn't really saying much. Judging from the long span of time between importations of the two subspecies, the "coerulea," variety inhabited areas off the beaten track of fish collectors. After a few years, it passed from the scene and became a rare fish, indeed. This was Mr. Gonzales' fish of 1934.

(2) There were other differences between the two *bivittatums.* The blue variety had a more lyre-shaped tail than its cousin. In addition, the markings on the blue variety were broken up, that is to say that the crisp dark markings now became irregular rows of blotches to some extent … this included both body and fin markings.

In 1933, Dr. Myers established correct scientific names for the two bivittatums. The original fish became *A. bivittatum bivittatum* and the blue variety became *A. b. hollyi.*

Although there is a definite possibility that the two species have long since been crossed, I am of the opinion that all of our present *day bivittatum* are *A. b. bivittatum* but that intensive coloration has altered (to a greater or lesser extent) coloration, markings, and fin shape. The reason I discount crossing between the two subspecies is that the *bivittatum hollyi* was difficult to breed, it was rare, and it disappeared from the aquarium scene long before World War II. To my knowledge, it was not imported after the war. In view of what aquarists have done to the guppy, it is not surprising to observe the results of inbreeding in other fishes. Ichthyologists, I suppose, are not interested in placing subspecific names on fish unless the form occurs naturally, as a result of geographic variation (it would keep them hopping to place names on all the varieties we aquarists develop!) I believe that aquarists should also make this distinction.

Aphyosemion calliurum has a story, too, and it is all the more interesting since it involves popular names. In the next issue, we will examine this provoking problem.

Aphyosemion – Part II

[Aquarium Journal, June 1961]

Continuing our discussion of last month, we find that the history of *Aphyosemion calliurum* parallels the story of *Aphyosemion bivittatum* almost to the proverbial "T." It first appeared in the same shipment that brought the two species to Hamburg, Germany, in the year 1908. Even more so than with *bivittatum, calliurum* had many scientific names but the one that caught on in the aquarium world was *Panchax calliurus.* Then, in 1932, another calliunini appeared on the scene. This was a striking bluish fish and so was immediately christened, *Panchax calliurus* var. *coerulea.* The analogy with *bivittatum* is very apt. The "coerulea calliurum," however, was the fish with the more definite markings in its fins as the original calliurum possessed spots and broken lines iii these areas. There were two more areas where the analogy broke down. Number one: There was little difference in the tail shape between the two subspecies whereas in the subspecies of *bivittatum*, this difference was pronounced. Number two: Both forms of *calliurum* bred readily. This latter fact provides the basis for believing that the two species could and have been crossed subsequently.

Again in 1933, Dr. Myers corrected the names of these two calliurums as follows: the original fish became *Aphyosemion calliurum calliurum* - and the "coerulea" variety became *Aphyosemion calliurum ahli.* This should end, once and for all, the argument over which fish should be called the "blue" calliurum, Note I said "should." However, since popular names are not currently regulated upon the basis of logical design (I think they should be), there is no "correct" or "incorrect" popular name. There are "logical" and "illogical" popular names, to be sure, but for these we have no court of appeals except to the individual aquarist.

Anyone looking at these two forms of *calliurum* will get the following impressions:
1. *A. c. ahli* is a "bluish" fish.
2. *A. c. calliurum* is a tossup between being a "reddish" fish and being a "yellowish" fish, with the nod going to the former.

It is true that *ahli* has some rather deep yellow edgings to its tail, dorsal and anal fins, but the general impression is that of strong blue with crimson markings (I am now looking at an excellent color slide of one of my breeders). On *A. c. calliurum,* however, the red markings stand out conspicuously because the background color here is either a very light blue or a weak yellow. If anything, *A. c. calliurum* should be called the "red" calliurum.

If this is the history and coloration of the species, then why the current confusion in popular names? Much to my regret, I have to place the blame on a number of prominent Dutch aquarists. However, this does *not* include Mr. DeLooze who did not use any popular name whatsoever in his article… his descriptions of the two subspecies coincide with mine except that he feels that the "yellow" edgings as I describe them are more "orange." His reference to the blue edgings of these fins in *A. c. calliurum* is certainly correct but this must be modified to say a very light blue, light enough indeed to even he called a pale white. The current Dutch use of "blue" and "yellow" have never been the German designations for these fishes as they refer to ahli as Ahl's killifish, and to *calliurum* proper as the red-bordered pa chat or red-bordered killie. The latest German reference, Sterba's great aquarium book, *Süsswasserfische aus alter Welt*, uses these popular names as did the comprehensive German reference work of a generation ago, *Die Aquarienfische in Vort and Bild*. As a matter of fact, the greatest single work on aquarium fishes (the amazing 15 volume, Het Handboek Voor De Aquariumliefhebber), incidentally published by the Dutch, states (and I am quoting now from volume 12, "Aquariumvissen uit Africa," written by Mr. W. Veldhuizen) that one of the principle differences between A. c. calliurum and A. c. ahli is the "hemelsblauwe kleur" of the latter! One doesn't have to know any Dutch to recognize the phrase, "sky-blue color"!

It is unfortunate that some American authorities recognize these misleading popular names.

As far as I am concerned, the logical popular names for *ahli* and *calliurum*, respectively, would be “blue” calliurum and “red” calliurum. If one has a real strong imagination, the “red” could be twisted into “yellow.” Once again, we point out the weaknesses of popular names for fishes. This is not to say that we should not use popular names but rather a plea for recognizing their pitfalls.

Mr. Gonzales raised the question of variability between these two subspecies of *calliurum* mostly as a result of his breeding experiences where he obtained wide variations in coloration and markings from but a single pair of fish. Unlike the case of *bivittatum*, both subspecies of *calliurum* are available here in the United States at the same time. They breed easily and cross easily. There is no guarantee that anyone’s fishes are pure subspecies (Mr. Gonzales’ fishes, included)… indeed, hybrids may be now working their way around the country. Be this as it may, the original subspecies were natural or geographical variations, considered deserving of subspecific names.

Finally, although I hesitate to bring in another complication, it is necessary. There have been references to an “*Aphyosemion calliurum schmidti*” in our aquarium literature. The one picture of this fish that I have noticed in an American aquarium magazine was, in reality, none other than *Aphyosemion calabaricum*. If such a subspecies does exist, I have never seen it or the scientific reference to it. If any reader has any knowledge of this minor piscatorial mystery, I would be happy to hear from him.

Breeding *Xenocara multispinis*

[Aquarium Journal, July 1961]

Day by day now, I look forward for someone to spawn our old friend, *Plecostomus,* the large sucker mouth catfish.* In the September 1959 issue of the *Journal,* I described the spawning of a closely related fish, *Xenocara dolichoptera,* and stated that for practical aquarium purposes, *Plecostomus* and *Xenocara* could be considered almost the same fish … aquarists have a tough time telling them apart. Recently a German aquarist (it was a German aquarist who spawned *Xenocara dolichoptera),* Fritz Pagelson, spawned another species, *Xenocara multispinis.* Basically, there is little external difference between the two species. The differences that do exist are confined mostly to coloration and size … *Xenocara multispinis is* smaller and darker than its cousin. In general then, *Xenocara* resemble coarse-looking *Plecostomus.*

The fish were purchased at the 1-1/2 inch size and in the span of two years, had grown to 3-1/2 inches and 2-3/4 inches for female and male, respectively. Size is not the only sexual criterion for *Xenocara,* however. Characteristic for the genus are the tentacles present on the border of the snout and underside of the head of the males. In *Xenocara multispinis,* these are small. The basic coloration of these fishes is dark brown punctuated with rows of black spots. The ventral area is grayish while the robust pectoral fins also exhibit rows of brownish-black spots. Another characteristic is the presence of a whitish spot on each of the two tips of the tail fin. As a matter of fact, Mr. Pagelson first mistook this adornment for fungus. As one can’t get the spots off a leopard with cleaning fluid, these whitish spots on *Xenocara multispinis* don’t come off with mercurochrome either!

One evening in late September (the fish were about 2 years old at this time), Mr. Pagelson happened to glance at his 50-gallon community tank and to his astonishment, witnessed some rather vigorous antics on the part of the usually phlegmatic female *Xenocara.* The tank had been decorated using plenty of driftwood and rock, flintstone in particular. One flintstone formed a high cylinder about 12 inches long with openings on three sides. The female was busy “dancing” around this stone. She would fasten herself first on one side, then on another. After a while, the male entered the stone cave and shortly afterwards, the female managed to enter for a look. The action alternated between inspections of the cave and chases around it. Mr. Pagelson called it a day at about midnight and turned off all lights.

The next morning, the male was found fanning the inner walls of the rock while the female, noticeably slimmer, remained outside indulging in her more usual activities. Unfortunately, a community tank containing barbs and tetras was no place for rearing catfish. With the help of a coffee can, both stone and catfish (male) were removed to a separate tank. This new tank contained water at 72°F (later raised to 77°F), a pH of 7.0 and a hardness of 10 DH (normal tap water). Fortunately, the transfer did not seem to disturb the fish.

In these new quarters, the eggs were clearly visible and in appearance, they resembled mustard seeds. Suspended from threads, they seesawed back and forth, and on the 15th day, hatched out. The tiny fry fell to the bottom and a number of them fastened themselves to the glass front of the tank. From this vantage point they were easily observed: their little tails oscillated like a pendulum from the yolk sac, and only the eyes could be clearly distinguished in the head. At this point, interest on the part of the male fish ceased.

Day after day, the visible numbers of fry increased. When they had reached a length of about 10 mm, a pink spot was noticed under the head at about the level of the pectoral fins. This turned out to be the heart (their bodies were quite transparent at this point) and it was timed at about 150 beats per minute! After 14 days, the fry had the form and coloration of young tadpoles and it was estimated that there were 40 young in all. Also at this point, the yolk sac had all but disappeared and the fry were much more active. First feeding consisted of lettuce leaves and finely powdered dry food. However, there always existed the danger of overfeeding with consequent pollution of the water. This is the identical problem faced in breeding *Loricaria* catfish. As a partial solution, strong filtration was used, viz. a bottom filter with the outlet pipe a distance above the water's surface. This provided extra aeration and prevented bacterial, acidification activity. This filtration was so strong that the water in this 20-gallon tank was completely circulated every 1% hours!

As a side experiment, Mr. Pagelson placed eight young into a long-standing smaller aquarium with normal aeration and filtration. In spite of the fact that identical feeding was provided, these fish died within three days. This seems to reinforce the belief that the fry of *Xenocara* (and also *Loricaria)* require very clean, well-oxygenated surroundings. At the one-inch size, the final count was 25 young *Xenocara,* all active and healthy.

Two youngsters from East Germany have written to me, requesting that they be placed in contact with American aquarists in their own age group. The first youngster, Dieter Reetz, understands English but writes only in German. He is 17 and besides the aquarium hobby, is interested in modem music. The second, Wolfgang Oehler, is 12 years old and writes a beautiful script. His German is very simply written and easy to understand. Again, this is an opportunity to combine one's hobby with the learning of the German language.

Dieter Reetz
Leuna/Krs. Merseburg
LWH - Lager A
Germany (DDR)
Wolfgang Oehler Schneeberg/Erzgebirge
Harbensteinerstrasse 9
Germany (DDR)
Zimmer 5

In order not to appear to be playing favorites, I may be able to place readers in contact with aquarists in other countries of the world also, notably Scandinavia, Belgium, Holland, and Switzerland.

***My good friend, Page Gardner, and I have obtained eggs from several female *Plecostomus*. Unfortunately, this was accomplished by dissection of recently demised specimens. Their eggs are very large, over 3/16 inches in diameter.**

Black Discus, Lyretail Black Mollies, Cryptocoryne Nomenclature

[Aquarium Journal, September 1961]

Well, I guess it finally had to happen after all, it happened to angelfish, why not with discus? A recent issue of HET AQUARIUM, the Dutch aquarium magazine, pictured two coal-black discus! The fish were bred by the renowned Dutch aquarist, Dr. R. A. H. Legro and appeared (only two of them, however,) in a spawning that ultimately resulted in 74 healthy youngsters of 13-inch diameter. Details will be forthcoming but the parent fish spawned in water of 2.8 DH and 7.1 pH. The black fish are a result of a mutation apparently of a recessive nature, and as might be expected, are extremely striking in appearance.

While we are on the subject of black fishes, another development was announced recently by Mr. Cheah Yang Meng of Singapore. Mr. Meng has produced a rather amazing black molly (see sketch). The dorsal and caudal fins are, in the males only, remarkably elongated . . . much in the style of a lyretail killie. Females, on the other hand, look about normal. The anal fin of the males, although still modified for reproductive purposes, sports a number of elongated rays. The first spawning in which this mutation appeared, contained about 10% of these lyretail mollies or "flag mollies" as they are being called. It has been found that

The New Flagtail Molly, illustrated by the author.

the variety breeds about 90% true. Unlike in the case of the black discus, this new breeding form of the black molly should reach the United States fairly soon. Already they are in the hands of German aquarists.

Nomenclature in the field of aquarium plants has proved to be a sticky subject in the past. Almost certainly, a number of plant names used by aquarists are incorrect. A little of the darkness is being cleared away, however, by the work of such respected botanists as Dr. H. C. D. de Wit of Wageningen, Holland; Dr. G. Taylor, Director of the Royal Botanical Gardens, Kew, England; Dr. Heino Heine, formerly of Munich, now of Kew; and many others. Some of the interim results of their recent investigations are as follows:

(1) It has long been known that the plant known to American aquarists as *"Cryptocoryne becketti," is* real*ly C. nevelli.* Furthermore, the plant has two forms: (a) a tall form with narrow lanceolate leaves and (b), a dwarf form with leaves growing horizontally (see photo). The latter is much used in the aquarium. The question arises, "What plant then, is *Cryptocoryne becketti*? Prof. de Wit has provided us with a surprising answer, one that will cause a rash of corrections in subse-

quent articles and handbooks. It seems that our old friend, *"Cryptocoryne cordata"* is really C. *becketti!* The photographs included here clearly show the differences between the two species. Wrong names are so firmly entrenched in the aquarists' vernacular that it will take many years before they are properly buried. Shades of *Barbus sumatranus* (really *B. tetrazona)* and *Thayeria obliqua* (really *T. boehlkei).*

(2) The Amazon sword plant has about as many "scientific names" as there are authors. Its correct name has finally been determined at Kew Gardens, England, as *Echinodorus paniculatus.* There are two forms: *E. paniculatus* var. *gracillis,* the common or narrow leaf sword, and *E. paniculatus* var. *rangeri,* the broad-leafed sword plant. The other names formerly given to the sword plant correctly belong to the following familiar aquarium plants:

Junior sword plant - *Echinodorus brevipedicellatus*
Pigmy chain sword plant - *Echinodorus tenellus* (formerly incorrectly known as *Sagittaria microfolia)*
Chain sword plant - *Echinodorus grisebachi* (two forms; a broad and a narrow).

The term, *"Echinodorus intermedius,"* when considering the grisebach variety *(E. intermedius* var. *grisebach)* is a synonym for *E. grisebachi.* In all other cases, it is considered by some botanists as a form of *E. tenellus.* In any event, this name is of doubtful scientific correctness although the proof available at the present is such that it cannot be abandoned completely yet.

The following verbatim account in Ian Derrick's column in FINCHAT, left me with aching sides. Aquarists should get a chuckle out of it!

"Just look at the McHarry kitchen … all modern construction, cream and green fittings, with a delicate peat moss ceiling. Seems Arthur, the family brain trust, cottoned on to the bright idea of boiling peat moss in the pressure cooker. Seeing as there was no cap on the cooker, Arthur decided to look how things were going - up went Arthur, cooker and peat moss. Fact is, a heavily bandaged Arthur's still up there - trying to recover his peat moss."

Aphyosemion calliurum, Discovery and Habitat of *Aphyosemion Walkeri*

[Aquarium Journal, November 1961]

In the June 1961 issue of the *Journal,* I discussed some of the historical developments behind the aquarium fish known as *Aphyosemion calliurum* (both subspecies, *A. calliurum calliurum* and *A. calliurum ahli).* It seems advisable to add a postscript now. Those aquarists having access to a copy of Dr. Innes' "Exotic Aquarium Fishes," will immediately perceive that his picture of *calliurum* does not agree, either in general or in detail, with the fish available today under this name. Innes' fish is slender and has a short dorsal fin set well behind the anal fin, whereas present *day calliurum is* quite different. I have had correspondence with four different ichthyologists on the "calliurum question" and in this they all agree - that the status of the species in the genus *Aphyosemion* today is hopelessly confused, being, as it is, plagued with inadequate original descriptions (plus the fact that many type specimens held in museums were destroyed during the war), highly variable forms and "species" which grade imperceptibly from one to the next (e.g., the "bivittatum complex").

The fish we now call *calliurum* was brought to Denmark in 1957 by the Danish zoologist, Birket-Smith (much of our present stock descends from this original importation since Col. Scheel bred these specimens and sent their eggs all over the world). He found them on the outskirts of Akure (a city in Nigeria, east of the city of Ibadan) in irrigation and drainage ditches. Surprisingly, he often found both varieties together! My own remarks on *calliurum* in the June issue apply, therefore, only to the pre-war fish, which was closely related to *Aphyosemion australe.* Our present day *calliurum is* more closely related to fishes such as *Aphyosemion calabaricum* and forms with these, a small complex of "switch breeders" within the genus.

Unfortunately, the problem does not stop here. There are a number of other "aphyosemions" which are in doubt as to their correct designation, also. Among these are *Aphyosemion petersi* (possibly an *Epiplatys* but probably an *Aphyosemion), Aphyosemion duboisi* (most probably an atypical *Epiplatys,* belonging to the *bifasciatus-senegalensis* complex within the genus), and *Aphyosemion schoutedeni* (an *Aphyosemion* surely, but its name is doubtful). The latest thought on the *gardneri-filamentosum-arnoldi* group is that all are forms are subspecies of *arnoldi.* I shall probably remark further upon this group in future columns (there is a possibility that the "giant *filamentosum"* available recently to U.S. aquarists is the true *arnoldi).* The point is, aquarists should not become too attached to these names - they are all highly doubtful and subject to change. If hobbyists recognize the situation for what it is, then I see no need in using these names *but on a temporary basis only!*

Descriptions of natural habitats of aquarium fishes are rare commodities in our hobby. They are, however, clues in the detective game aquarists play to learn more about their fishes and their requirements. The following is an account by a German aquarist, Klaus Kluge, of discovery and natural habitat of the Ghana aphyosemion, *Aphyosemion walkeri,* during his student vacations.

Along the cost of Ghana, from the city of Takoradi to Alenda on the Tano river (whose lower course forms the border between Ghana and the Ivory Coast), is a road. As it is, it really isn't much of a thoroughfare but about 19 miles before this road ends (traveling in a westward direction away from Takoradi) it is intersected by a narrow dirt road.

Fortunately, it accommodates vehicles such as the Volkswagen Kluge used, although during the rainy season, even an amphibious craft would have trouble negotiating this trail. In any event, this side road winds through rather thick bushes and after an interesting drive dodging palm trees felled by the last winds, ends in a clearing overgrown with reeds and grasses. Here, in a series of shallow "lakes," the first *Aphyosemion walkeri* were collected since their initial discovery many years ago.

A superficial analysis of water conditions offered up the following information: water hardness, 1:5 DH; pH, 5.7; water depth variable, from 4 to 28 inches. In spite of the tropical sun that beat down upon these relatively open waters, the water itself was comparatively cool, ranging from 73 to 81° F. In those parts of the water not grown in with rushes, yellow water lilies bloomed on the surface. Here, under their leaves, were found specimens of *Aphyosemion walkeri.* They were not concentrated in great numbers but each sweep of the net brought up some fish.

The smallest males were less than a half-inch in length, the largest were about two and a quarter inches. Females, on the other hand, were somewhat larger but both sexes were found in about a 50-50 ratio.

The bottom layer of this milieu consisted partly of mulm and partly of plant parts, decaying and trampled grasses. Along with *walkeri* were found: *Barbus lineomaculatus, Nannaethiops unitaeniatus* and a number of

Hemichromis fasciatus, large and small. Since this is typical savanna country (as it is definitely out of the rainforest belt), it brings to mind the natural habitat of certain *Nothobranchius* species in Mozambique. There too, a number of cichlid and barb species are found along with the killies. The former are there by virtue of the extensive flooding which characterizes the rainy season. This accident of nature costs them their lives, including the nothos, but at least the eggs of the latter survive in the dried mud to perpetuate the species.

Three weeks after visiting the scene just described, Kluge returned only to receive a shock. The junior-sized lakes were, in some places, almost completely dried. The natives, in order to provide relief for their goats and cows, had removed all the vegetation from the water in many places. Here, the water was muddy and warm and not a single fish was to be seen. Those pools still containing plants harbored only a few fishes. A considerable number of *walkeri* were found in places only an inch in depth, with water temperatures exceeding 100° Fahrenheit! In such places, connections to deeper water were still intact, the fish presumably returning to these inhospitable appearing areas in order to breed. Surprisingly, they appeared to be well nourished and had excellent coloration.

Four weeks later, the region had dried out further. Deep fissures appeared in the dried mud bottoms and buried within, were the eggs of our killifish. In those rivulets still containing water, isolated specimens of *walkeri* were still to be found although they were small, had frayed fins and lacked the usual brilliant coloration. As Kluge remarked, they certainly would undergo a wretched existence until the next rains came, four to five months later.

The following advertisement was sponsored by the United Guppies of Hawaii and appeared in the bulletin of the Canadian Aquaria Society!

Have you spent every waking moment of your day in fear of your life?
When you go to bed at night, do you wonder if you will see the rising sun the next day?
Have you had your children killed before your very eyes?
Have you ever had a baleful eye fixed on you so that you were afraid to move?
Do you go pale and lose weight through constant worry?
Do you believe in "live and let live"? Will you help the downtrodden?
We don't ask much - just a little help.
Won't you help us to help ourselves?
HELP STAMP OUT CICHLIDS!

Experiments in the Prevention of Fungus in Killifish Eggs

[Aquarium Journal, December 1961]

For many years, I have witnessed a steady flow of articles, short notes, and letters in the aquarium literature, concerning the powers of methylene blue (a common dye) to prevent egg destruction as a result of either bacterial or fungal activity. I should hate to appear smug about this problem, but my own experience has shown that egg destruction can be kept to manageable proportions, although it is not alone a matter of which dye to use.

The eggs of killifishes, in particular, present additional problems due to their relatively long incubation time. Since I have always handled a good many of these eggs one at a time (via the tweezer method) and have been interested enough to follow their development through the microscope, the problem of egg destruction has been a major concern to me. In these instances, I frequently turn to considerations of problem fishes (and if egg destruction is a problem, I deem the fish to be a problem) in their natural habitat, for Nature has already solved these problems in her own way. Most water analyses of the regions inhabited by killifishes show that these natural waters are low in dissolved "hatching solution" to start out with, I devised a solution consisting of distilled water plus peat extract (the extract made by boiling peat in distilled water). Since the peat extract I use regularly tests out at a pH of 3.5 (electric meter) and since about 1/20 of the hatching solution consists of this peat extract, the resultant solution is still quite acid. I have often read admonitions of pH and osmotic shock to fish eggs transferred from relatively hard, alkaline waters to relatively soft, acid waters but I have found that such fears are mostly groundless. As a matter of fact, as far as osmotic pressure is concerned, newly laid eggs rely on a healthy osmotic pressure difference for certain physical changes that must take place in the shape of the egg and in the amount of water it ultimately contains.

In all my dealings with killifish eggs, I try to maintain a scrupulously clean media in which to hatch out the eggs. In most cases, this includes filtering of the hatching solution. But examination under the microscope has shown that “cleanliness” is also a relative term. Bacteria are always present … there is nothing one can do about this except in degree (eggs could be hatched out in a germ-free environment, but this is hardly a practical solution for the breeder). The addition of a suitable dye, and here we return to the real subject, does have an effect on egg destruction statistics, however. After a number of years of experience with hatching out killifish eggs, I discarded methylene blue in favor of acriflavine (a greenish-yellow dye, obtainable from your local drug store on order in powder form or from your dealer in fishes in a liquid form). Qualitatively, I had always thought the former to be worthless. As a result of some recent experiments in another field, however, I am able to supply the following data to support this statement. The eggs of five different species of killifishes were involved. All of the eggs (gathered about the same time) were placed in the hatching solution described and stored in plastic, compartmented boxes. However, two solutions were used, identical except that the one had methylene blue added and the other had acriflavine. It is difficult to really make concise statements about the concentration of these dyes used but as these experiments were originally directed towards another goal, the dyes were added in that concentration short of where the eggs were actually dyed (by experiment, the reader can determine this point for himself since it varies with the species involved and other factors). In the case of methylene blue, this is a moderately deep blue color. The same holds true for acriflavine although being yellow, may seem to be less intense in coloration. It is surprising how much acriflavine fish eggs can take. On the other hand, it is far easier to overdose with methylene blue ... in such cases the eggs are practically worthless since there is an apparent interference with natural cell division.

The results are shown in Table I. Numbers in parenthesis show the number of eggs involved. GTR is an abbreviation for the goldentail rivu-

TABLE I

PERCENTAGE EGGS DESTROYED (BY BACTERIA OR BY FUNGI)

Species	Methylene Blue Solution	Acriflavine Solution
Aphyosemion “calliurum ahli”	2.7 (37)	0.0 (9)
GTR	50.0 (2)	16.7 (6)
Epiplatys sexfasciatus	40.0 (5)	7.7 (13)
Pachypanchax playfairii	57.6 (66)	10.1 (79)
Pachypanchax homolonotus	46.5 (43)	10.3 (29)

lus, a fish that offers certain problems in identification at the present (the same may be said for *Aphyosemion "calliurum ahli").*

A number of statistical tests were applied to these data and they resulted in demonstrating statistical significance at a high (95%) confidence level that the choice of dye is indeed, a factor. Using methylene blue, 40.5% of the eggs were destroyed; with acriflavine, this percentage decreased to 9.6. The results would have been even more interesting had a control been present, i.e., a hatching solution with no dye added whatsoever.

In some instances, the number of eggs involved was too few to make meaningful statements concerning particular species. This experiment confirms, however, other observations I have made over the years. Thus I would suggest that aquarists switch to acriflavine in lieu of methylene blue. This says nothing, of course, about malachite green, a dye of some value to the aquarist also. Perhaps this column will discuss the use of this dye in the future.

The egg destruction problem, at least as far as killies are concerned, resolves itself really into two parts. The first is with the matter of initial or primary egg destruction. The second is the matter of "spreading" … one bad egg affecting healthy eggs. Perhaps we as aquarists take too much for granted when we unconsciously assume that all eggs are fertile to begin with. I suspect that more infertile eggs are laid than we think. Such eggs, of course, will invite bacterial attack in spite of any dye used. Thus, the really critical problem is the second one, that of egg destruction "epidemics." Many qualified authors have written about ways to prevent these epidemics but one sure way is to use isolation (keeping neighboring eggs from touching). A single egg could be placed in its own vial, for example, but this would introduce additional problems. The surface volume relationship in a small vial is conducive to bacterial growth, for one thing, and handling a number of small vials is inconvenient, for another. I have conducted a number of experiments in which freshly laid eggs of typical plants spawners *(australe, bivittatum, chaperi,* etc.) are placed in very moist peat moss, packed in plastic bags and stored for a number of weeks in a dark area at a suitable temperature. After the proper amount of time has elapsed, the peat is placed in water to hatch out much the same way as in the case of the annuals. This method works exceedingly well and I sometimes recommend it to beginners who do not wish to bother with special hatching solutions and containers. As a matter of fact, if I had not been able to eliminate most of my own egg hatching problems (I consider a 10% loss, "living with the problem"), I would have switched to this method myself. Of course, I use this method for certain species occasionally, and for shipping killifish eggs.

It is, of course, added trouble to remove the fry when they are swimming in a shallow container over a peat bottom.

One occasionally hears statements to the effect that this procedure prolongs the hatching time of the plant breeders, but although this can be true at times, it is a function mostly of the water content of the peat. If the peat is really wet, hatching times remain about the same.

Killifishes lend themselves to egg experiments, it is true. It is interesting to compare, for example, yields from a single pair with those from a trio (one male and two females) of fishes of the same species. Presently, I am gathering data concerning this. But in any event, I am sure that at least some of the knowledge gained with killifishes can be carried over to be applied to other fishes which are characterized by moderately-long egg hatching times, e.g., cichlids, gobies, etc. The instance of acriflavine versus methylene blue is a case in point.

Rules for Common Names
Part I

[Aquarium Journal, January 1962]

From time to time, mention is made in the aquarium literature of scientific names for fishes together with the rules and regulations concerning their proper usage. The aquarist is led to believe (and correctly for the most part) that these rules and regulations serve to replace chaos with order. No one, however, has ever said anything about guidance rules for common names, an area in which conditions are certainly not immune to chaos, especially when one considers that "just any old body" can spew forth with popular names faster than form 1040's at income tax time!

As you have probably noticed, the Journal takes a consistent stand re common names for fishes — in other words, it has a definite policy. You probably have noticed also that other aquarium magazines have policies of their own and that they frequently do not coincide with the Journal (no criticism intended!). For example, one publication may print "Blue Gularis," while another may print it as "blue gularis."

Because of the importance of common names to our hobby, I would like to discuss some aspects of the common or popular name problem and present some suggestions that may possibly form a basis for hobby-wide standards in this field.

In 1951, the American Fisheries Society approved a plan whereby the Committee of Names of Fishes of that Society would serve jointly as a Committee on Common Names of Fishes in the American Society of Ichthyologists and Herpetologists. The latest effort of this Committee is a small book entitled, *A List of Common and Scientific Names of Fishes From the United States and Canada*. Because it sets forth principles governing the selection of common names, this book is of great interest to the aquarium hobby. To a considerable degree, it is these very same principles to which the Journal subscribes. However, I would like to critically evaluate these principles, discarding those which are not applicable to our hobby and those which 1 feel are unacceptable as valid principles at all, but urging wide-spread use of the remainder. One thing should be made clear at the start. The ichthyologists who are members of this Committee are most distinguished in their fields and have given unstintingly of their time to a difficult project that brings them no personal gain. Nevertheless, a number of equally distinguished ichthyologists do not accept all principles without reservation. Although I am a member of one of these Societies, my following remarks are intended only for consideration in the light of the adoption of a number of these principles for aquarium consumption, and should not be misconstrued as criticism of either of the two Societies mentioned.

The easiest way to discuss these principles is to present them one by one, each followed by my own comments. Each principle will be quoted directly.

1. "A single vernacular name shall be accepted for each species or taxonomic unit included."

This is a logical beginning and one principle that should be adopted by all aquarists. It means only one popular name to a customer! For example, the use of both "striped gourami" and "giant gourami" for *Colisa fasciata* is highly confusing. One or the other should be discarded.

2. "No two species on the list shall have the same approved name."

Amen! All the aquarist has to do here is to recall the number of different species referred to as "silver tetra." This is even more confusing than abrogation of Principle No. 1.

3. "The expression, 'common', as part of a fish's name shall be avoided wherever possible."

Although this is a real problem with the names of native freshwater fishes, the aquarium situation is quite different. There is a real need for the use of terms such as "common guppy" and "common swordtail," to distinguish between ordinary specimens and the highly developed fishes of the hobby specialist. However, the word "common" as used here is more an adjective than part of the name. Since aquarists in all other instances have shown far greater imagination in their choice of popular names than to continually use the word "common," I do not think this principle is particularly apropos to our hobby.

4. "Simplicity in names is favored."

Here are a number of rules that I would really like to see applied on a broad scale. Hyphens, suffixes, and apostrophes should be omitted except when they are orthographically essential. For example, use "bluefin," not "blue-fin." However, "three-spot gourami" is preferable to "threespot gourami" as the latter may lead to misunderstanding and relate the origin of the name to "pot." In the case of "three-eyed," the hyphen is essential.

Do not, however confuse this practice of simplification with the running together of compounded modifying words, for the wholesale practice of combining words, especially those that are lengthy, awkward or unfamiliar, is to be deplored. For example, use "black molly," not "blackmolly." For names established for generations where there is no danger of confusion, this rule may be broken, e.g., "goldfish." In any event, terms such as "blackbanded sunfish" "redtail shark" and "wagtail platy" are highly acceptable.

5. "Common names shall not be capitalized in text use except for those elements that are proper names".

A good rule. For example: "cardinal tetra," but "Peruvian longfin."

6. "Names intended to honor persons e.g., Allison's tuna, Julia's darter) are not admissible.

An excellent rule for taxonomic units at the level of species, I much prefer "neon tetra" and "cardinal tetra" to "Innes tetra" and "Axelrod's tetra." Many aquarium authors manufacture book names in this manner and in my opinion, it is a waste of time and very poor judgment. However, in the matter of aquarium-bred varieties, I see nothing wrong in honoring the breeder in this manner. Therefore, we have the "Simpson swordtail" and the. "Cosby gourami," and if one is willing to take the time and trouble to define these terms (this may be the real difficulty!), then I see nothing wrong with their use.

7. "Only clearly defined and well-marked taxonomic entities (usually species) shall be assigned common names."

The Committee points out that subspecies are rarely of importance to laymen and therefore state that most subspecies are not suitable subjects for common names. This is clearly not the case for aquarists, however, and this principle must be rejected here. The use of the terms ""blue calliurum" and "yellow calliurum" for *Aphyosemion calliurum ahli* and *Aphyosemion calliurum calliurum*, respectively, can hardly be challenged on these grounds.

8. "The common name shall not be intimately tied to the scientific name."

The Committee takes the position that since scientific names are subject to change, the common name should not be linked with it. The object here is to obtain a stable common name system. This principle has been criticized by a number of prominent ichthyologists and I think that we as aquarists can safely ignore it also. The history of such applications within our hobby indicates that there is no danger of so introducing instability into our popular names. The use of the terms "tetra" and "guppy," for example, illustrate this point nicely. It makes little difference that these terms are linked to existing or historical scientific names. It is only when aquarists cling to discarded scientific names as scientific names that they get into trouble (e.g., "*Panchax lineatus*").

9. "Names shall not violate the tenets of good taste."

No comment needed here!

Notes on nos. 10 through 19: These principles are really criteria that can be regarded as aids in the selection of suitable popular names. Since the Committee list is for fishes from the United States and Canada, some of them are not applicable to our hobby.

10. "Colorful, romantic, fanciful, metaphorical and otherwise distinctly and original names are especially appropriate."

Examples: "phantom tetra," "archer fish" and "rummynose tetra."

11. "American Indian names are welcome for adoption as common names."

If extended to include native names of other countries, this is a helpful criterion. The names. "gourami," "chanchito," and "betta" are examples of native names or modifications of native names.

12. "Regardless of origin, truly vernacular names that are widespread and in common use by the public are to be retained wherever possible."

This principle is not particularly apropos to our hobby.

13. "Commonly employed names adopted from traditional English usage (e.g., cod, pike, sole, flounder, bass, perch, chub, minnow) may be given considerable latitude in taxonomic placement."

An example of stretching this latitude a bit is "redtail shark," which is certainly not a shark! Since aquarists will be aquarists, I agree with this statement by the Committee.

14, "Structural attributes, including color and color patterns, are desirable and are in common use in forming names."

Examples: "sailfin molly," "humpbacked limia," "giant danio," and "black tetra."

15. "Ecological characteristics are useful in making good names."

Examples: "rock rivulus," "freshwater flounder," and "mudskipper."

Rules for Common Names – Part II

[Aquarium Journal, February 1962]

16. "Geographic distribution provides suitable adjectival modifiers."

A very useful criterion. Examples "Peruvian longfin" and "Australian rainbow fish." However, beware of names such as "Congo cichlid" where the fish actually comes from another area, in this case, South America! Such names are definitely not acceptable. *[Aquarium Journal, Editor's note: Problems will arise here. For example, the name Amazon molly does not refer to the geographic distribution of the fish. It has reference to that mythical race of female warriors! — S.W.]*

17. "Generic names may be employed outright or in modified form as a common name."

Example of outright form: "rasbora" (commonly used for *Rasbora heteromorpha).* Example of modified form: "molly" (from *Mollienesia).* The rule here is that these common names should be written in Roman type and without capitalization. This rule is very difficult to apply at times. If one uses the term "aphyosemions," it obviously is in a popular sense since there is no such taxonomic name. However, "aphyosemion" could be used either in a popular sense (e.g., "blue aphyosemion") or in a scientific sense (e.g., "These species of *Aphyosemion* are …).

18. "The duplication of common names for fishes and other organisms should be avoided if possible, but names in wide general use need not be rejected on this basis alone."

In other words, "butterfly fish" is acceptable, but "butterfly" is not! On the other hand, "buffalo" is so commonly used for certain suckers, that it is still acceptable. These examples are so unusual that this principle is not particularly applicable to our hobby.

19. "Names that appear on official lists of names of fishes prepared by other agencies shall be preferred."

I note on the Committee's own list, a number of very acceptable popular names and a number of (to me) very unacceptable ones! For example, I have just received a trio of *Fundulus confluentus* and am looking for a suitable common name. The Committee's name, "marsh killifish," is not acceptable to me although I would accept "marsh fundulus." Aquarists have long since known *Chriopeops goodei (=Lucania goodei)* simply as the "bluefin," but the Committee lists it as "bluefin killifish." Therefore, aquarists should examine such lists with much care and deliberation before they are accepted. *

This completes the set of principles laid down by the Committee. As you have seen, some would be of benefit applied to the problem of aquarium common names, while others would not.

Finally, I would like to take violent exception to any thesis that states that *all* species of fishes must be given common names if by this, we mean some name not allied to the scientific name. What is the sense, for instance, in trying to devise a "popular name" for the bivittatum *(Aphyosemion bivittatum)?* Authors writing in handbooks are forever manufacturing "popular names" when the need for them does not exist. I once saw the term, "Golden Pheasant" applied to *Aphyosemion sjoestedti* in a handbook. This "popular name" not only violated principles 17 and 18, but is not accepted by any significant segment of the hobby. Now *sjoestedti* is not the easiest thing to pronounce on first sight (**SHUSS'**-TED-EYE is close enough as this is one of those foreign words which has no exact pronunciation in English), but one having heard it, it is no harder to pronounce than "mudskipper." Indeed, many hundreds of killifish fanciers use this term day in, day out. The term, "Golden Pheasant" will never be used and like all others of its kind, should be relegated to the nearest "file 13" (the wastepaper basket!).

In this discussion, I have not tried to set out rules for common names but rather have examined procedural dicta for two professional societies related to our hobby, I hope the "best" of these dicta will be adopted throughout the hobby and used by the aquarists in a position to name fishes. The subject is by no means closed; indeed it has just been opened. Perhaps hobby associations such as the International Federation of Aquarium Societies and the American Killifish Association will take it from here.

***My objection to the use of "killifish" as part of a common name is that this term is applicable to possibly 400 fishes. It, in effect, wastes half of the common name by its excessive generality. Killifish fanciers are especially interested in the relationships among their fishes and are disinterested in generalities.**

Shipping Fish and Fry, Cryptocoryne Disease

[Aquarium Journal, March 1962]

On Thanksgiving Day, 1961, I was awakened by the sound of the telephone, a particularly unwelcome noise as one of the minor things I was thankful' for that day was the rare opportunity to snooze past 8 a.m. Since it turned out to be the airport notifying me of a shipment of fish, I could not grumble much, however. An hour later found me downtown at the docks of the shipping agency, waiting for the truck from the airport. While outside stomping my feet, trying to keep warm, I noticed a package containing tropical fish sitting on a small hand truck. It was clearly labeled, "TROPICAL FISH, KEEP WARM, 75-80° F." After mumbling to myself that the shipping agency had only missed the temperature by a mere 30 to 40 degrees, I noticed the shipping date on the package - November 16th! Since this was Thanksgiving Day, the 23rd, I began muse upon the unfortunate sequence of events that undoubtedly condemned an unknown number of aquarium fish to a cold and suffocating death. A few questions asked of the man in charge brought out the dreary information that the situation arose from a rather unusual train of events that I will not detail here. The point is, however, I know of one step that could have avoided this piscine tragedy.

I carefully examined the box and was unable to find the one thing that should have been there - the legend, "Call (and here the receiver's telephone number) from the airport," or some such similar legend. I have used this particular shipping agency countless times and have never lost a fish, but then my telephone number was on every single shipment.

Let's face it, no shipper has any really adequate provision for handling aquarium fishes, but they all are quite happy to notify receivers when their shipments are in (even on Thanksgiving Day!). The losses in shipping fishes occur not during flight, but rather in waiting or on cold docks or in unheated rooms (or conversely, in full sunlight during the summer months). The moral is clear, if you have occasion to ship fish or have fish shipped to you, don't forget that telephone number! Incidentally, the truck arrived from the airport in due time and I happily took 10 rare (and healthy) fishes home for the holidays.

While we are discussing shipping fishes, it might be appropriate now to report the results of an interesting experiment along these lines. After trying unsuccessfully to ship some killifish eggs to Bruce Turner of New York City (they just didn't seem to want to hatch out even though I shipped eggs with visible embryos), I decided to ship live fry instead! On a Thursday morning, I placed a number of eggs of *Epiplatys sexfasciatus* and *Pachypanchax homalonotus* into a Petri dish filled halfway with water to which I had added a few drops of microworm culture. The eggs were two weeks old and ready for hatching.

That evening, all had hatched out. I placed about 2 dozen in an ounce (that's no error, I mean 1 ounce of water!) of water in a very small plastic bag, and popped the bag into a small cardboard box about 4 x 4 x 1% inches. The box was duly addressed and the only special legend it bore was, "Hand Stamp Only." On Friday morning, my wife took the package down to the post office and had it sent parcel post, airmail, special delivery (charges were 600). The 670-mile trip (during the coldest weather we have had in years) evidently took a day and a half for the fry arrived around Saturday evening at Bruce's house. Unfortunately, Bruce was away for the evening with a young lady carefully explaining, as he tells it, how one hatches out *Nothobranchius* and other annuals. Be that as it may, his mother placed the package on his dresser, thinking it contained some inanimate object (by that time, it well could have!). Bruce's lessons on *Nothobranchius* et al with his companion were not over till the "wee hours" and so he didn't get the fry into a tank until 8 a.m. Sunday. I quote his report verbatim: "Ha, ha! You bested yourself! *Every* single one of those fry came through on Sunday morning alive and they are doing well!" A month later, they are still doing well.

We are extending our experimentation to include distances of several thousands of miles in order to see just what distances are feasible. Our feeling is that if the fry are newly hatched, their yolk sacs will carry them through shipping. In any event, it just goes to show how interesting this hobby can be!

Those of you who have never experienced the malady popularly known as the "cryptocoryne disease," are lucky indeed. The disease can decimate a plant within a few days and in some cases, even within a few hours. Characteristically, the disease commences at the top of a leaf and works its way down parallel with the vein network of the leaf. Thus, the leaf often looks as if it had two points. More rarely, the disease attacks the stems, leaving whole leaves to float at the surface. In three days, a healthy plant can be reduced to a slimy pulp, a situation that may spread rapidly throughout the tank.

Certain species of *Cryptocoryne* have proven less resistant to the disease than others, viz., g*riffithii, becketti, undulata* and *affinis.* More resistant are the rarer species such as w*endtii, rubella,* and *lutea,* although n*evillii is* fairly resistant and is common in the aquarium. In a letter in the German aquarium magazine, ATZ, Mr. H. W. Pelz describes a hydrogen peroxide treatment that proved to cure or at least to bring the course of the disease to a halt. Mr. Pelz used 50 ml of a 3% hydrogen peroxide solution per 25 gallons of aquarium water. The peroxide then liberated oxygen that clung to the leaves in the form of small bubbles. Fortunately, the decomposition of peroxide leaves no harmful products to accumulate in the aquarium (the peroxide decomposes into water and oxygen). The fish should be removed during the treatment. It remains to be seen whether or not peroxide really is of value in treating this rather distressing aquarium malady although Mr. Pelz repeated his success a number of times and under a broad spectrum of water conditions.

Surinam Fishes, Octopus, Surgery in Britain

[Aquarium Journal, April 1962]

A recent issue of the Dutch magazine, HET AQUARIUM*,* contains an interesting article on the headstander, *Chilodus punctatus***,** by F. J. Van de Vlugt, the renowned Dutch hobbyist. What caught my eye was the fact that a friend of Mr. Van de Vlugt personally visited and netted specimens while in Surinam (Dutch Guiana). Most aquarists think of the headstander as a Brazilian fish but it ranges farther north, also. The northeastern portion of Surinam is a rich bauxite-producing area, bauxite being the mineral vital to production of aluminum. About 22 miles from the town of Albina on the way to Moengo (the center of the bauxite region), is a very small river called the Rikanau. Here, Mr. M. P. Pijpers found numerous headstanders. Figure 1 shows a schematic diagram of this immediate area. The bridge is only 50 feet long and nearby, a railway to the bauxite mines parallels it. The center of the river averages about 20 feet deep and numerous small creeks lead off from its banks. The banks themselves are overgrown with various kinds of grasses and one bank is particularly low, forming a marshy area during the rainy season. However, at the height of the dry season, this bank is quite dry.

In the water, but close to the banks, are found concentrations of luxuriant plant growth, partly cabomba-like and partly of the mucka-mucka type (this is a native name for *Caladium arborescens).* It was in the vicinity of this heavy plant growth that the headstanders were found: When Pijpers was there, it was more or less in the dry season, and so the cur-

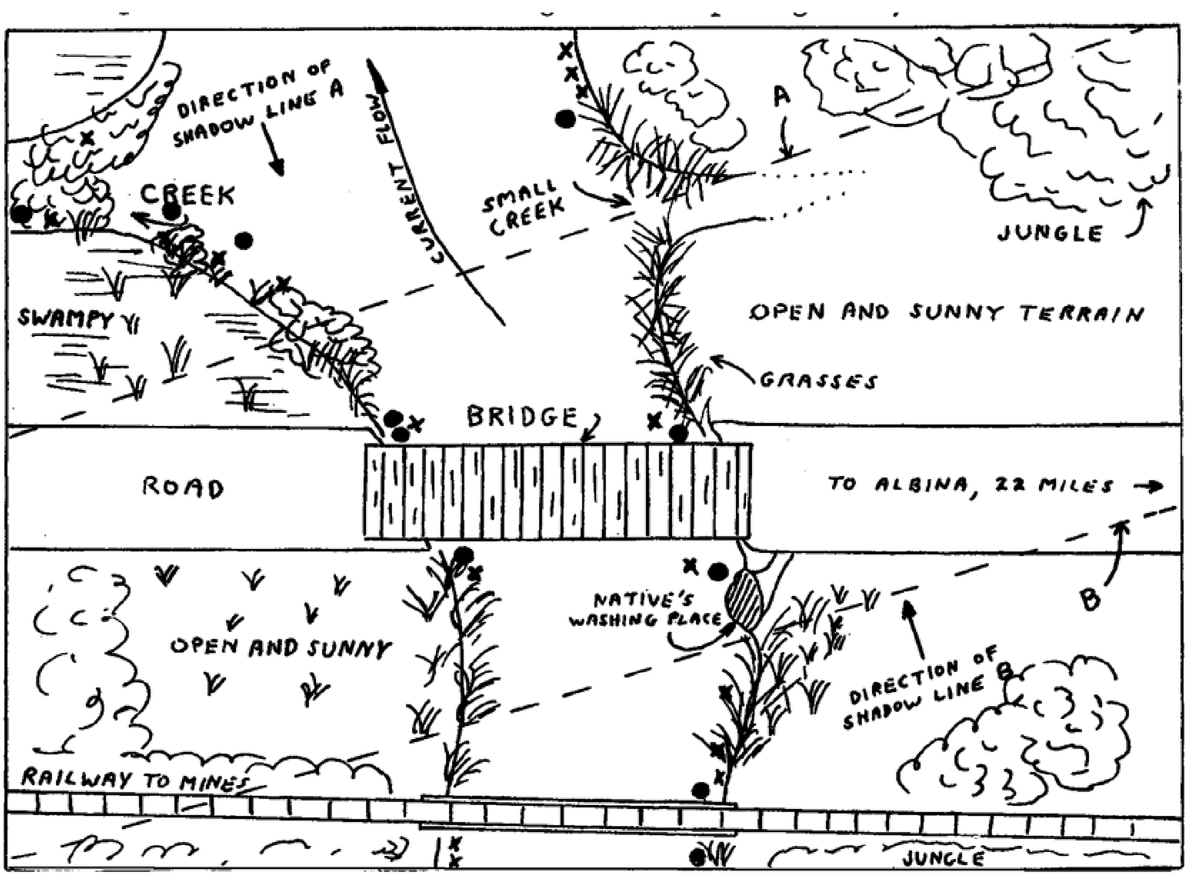


Figure 1: The Rikanau Bridge in Surinam. Sketch after Van de Vlught.

rent in the Rikanau was rather weak. In general, the water was not really dirty but there were great concentrations of decaying plant materials along its banks, these areas, of course, being quite cloudy. The natives had a "laundry" under the bridge on one side, but even here, headstanders were captured! Adult fishes were observed in schools and many young were raised in the vicinity of debris and rubbish-surrounded plants. Water temperature at the surface measured between 82 and 84° F, although during the warmest part of the day, this rose to 86 to 90° F.

A foot under the surface of the water, the temperature was about 2° lower, while the bottom temperature measured between 75 and 77° F. The headstanders, quite understandably, were found not at the surface but near the bottom. Apparently they were little affected by light reaching the Rikanau since they were found in areas of the river both shaded and exposed to the sun. However, the thick aquatic plant growths provided their own shade.

Along with *Chilodus* were found: *Carnegiella vesca, Gasteropelecus sternicla, Charax gibbosus, Pyrrhulina filamentosa, Crenuchus spilurus, Leporinus friderici, Metynnis* species, *Nannostomus beckfordi, N. bifasciatus, N. trifasciatus, Hypopomus* species (a knife fish), *Polycentrus schomburki, Aequidens maroni, Crenicichla saxatilus* and *Curimatopsis macrolepis,* all aquarium fishes. What a marvelous spot for an aquarist! Yet, the natives wash their clothes here without a thought to the many fishes that swim nearby and that we prize so highly.

For some reason, the octopus has always fascinated me and although I do not consider my-

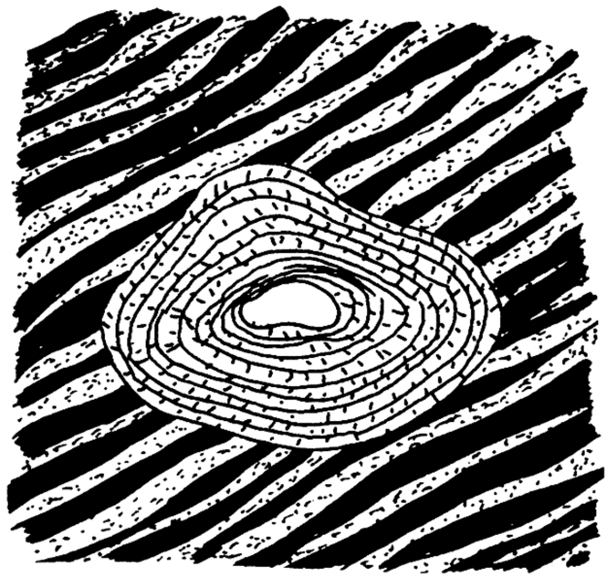


FIGURE 2. Hole drilled in abalone shell (*Haliotis fulgens*) by a large *Octopus bimaculatus* (armspread, five feet). Size of hole at top, 0.8 mm long, 0.6 mm wide. Size at breakthrough, 0.3 mm long, 0.2 mm wide. Sketch after photo by A. 0. Flechsig.

self a marine aquarist, I have always followed the literature on this bizarre creature with much interest. Recently, a report by Messrs. Pilson and Taylor of the Scripps Institution of Oceanography (University of California, La Jolla) came to my attention that is worthy of mention here.

Saltwater enthusiasts know that a large portion of the diet of an octopus consists of shellfish, and it is also known that the octopus opens such animals by attaching some of its suckers to the two halves of the shell and exerting outward force. After a while, the shellfish (mussels, abalone, oysters, etc.) tires and for the octopus, “soup’s on”! The authors of the report in question had noticed that in an aquarium containing specimens of *Octopus bimaculoides* and *Octopus bimaculatus,* and abalones, the last-named had small holes in them of an unusual nature. A number of various mollusks were added and after they were eaten by the octopus, their shells were carefully examined. A sloping hole was discovered in most shells, surprisingly small considering the size of the octopus involved (see figure 2). These holes were decidedly smaller than those generally made by carnivorous snails.

Now carnivorous snails eat shellfish by drilling a hole and then introducing their proboscis through the hole and rasping the flesh of its prey. Clearly, this is impossible for so large a creature as an octopus, and so small a hole. Our scientists concluded that the octopus instead injected venom of some sort that caused the shellfish to relax, weakening its closure muscle mechanism. One octopus was observed in this deadly little process. From the time it attached itself to an abalone to the time the abalone called it quits, it took just three hours. The abalone was rescued just before the octopus applied the coup de grace, but the abalone remained groggy for two weeks, afterwards recovering but still sporting a tiny hole.

Of interest was the fact that the octopus drilled not with its beak but with its radula, the scrapers contained within its mouth. It has long been known that the salivary glands of the octopus contain venom, which is frequently used for paralyzing crabs. When an extract of these glands was injected into the foot muscles of abalones, the result was that the abalones were easily removed from the aquarium wall (normally almost an impossible job!), in fact, they died within two days.

The question now is, what prompts the octopus to choose between these two methods of attacking shellfish? When brute force (and the octopus’ patience) wears thin, does the octopus resort to its sneak chemical attack? In any event, it is too bad that the octopus drills such a small hole. A trained octopus could prove a godsend for those aquarists needing holes drilled in glass to admit air line tubing, heaters, thermostats, etc.!

While reading the latest copy of the British magazine, THE AQUARIST AND PONDKEEPER, I chanced to note a letter from a correspondent discussing the problem of fin rot on a specimen of *Corydoras paleatus.* The gentlemen in question suggested that cutting off the afflicted parts might be a worthwhile solution but remarked that in Great Britain, this comes under the heading of surgery and so, is illegal! I rather suspect that there are a lot of unpunished "criminals" running around Great Britain, and I wonder what the penalty is for such a heinous offense? If cutting off a fin is surgery, then surely treating with salt, acriflavine, etc. is medicine and as such, also illegal for all but bona fide MD's!

Construction of Large Tanks

[Aquarium Journal, May 1962]

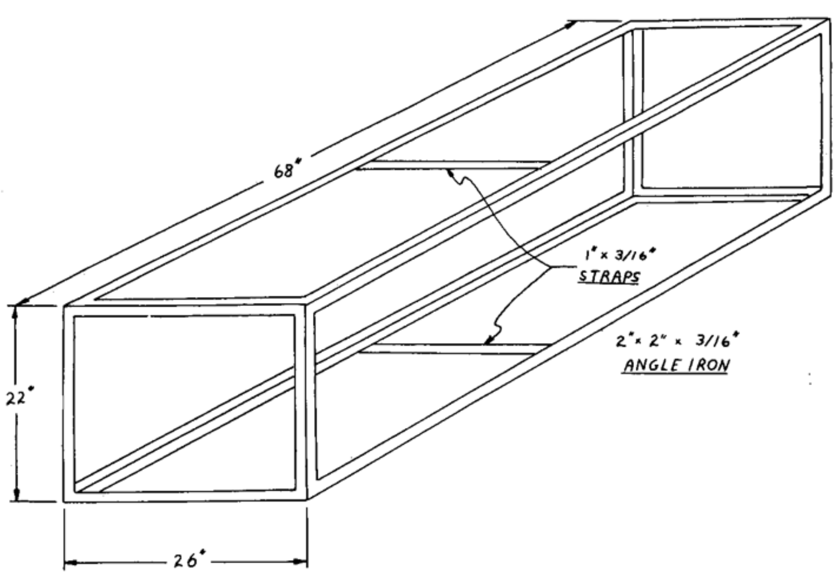
A correspondent from Bakersfield, California, Mrs. Virginia Williams, has recently requested that I discuss construction details of some large tanks, which I have made myself and mentioned from time to time in the JOURNAL. Since there are involved a number of innovations, which may be of interest to other aquarists as well, this month's column will be devoted entirely to this subject.

First of all, I should like to comment briefly on the advisability of constructing one's own aquaria. It has been my experience that, excluding any psychological satisfactions involved, an aquarist is justified in constructing an aquarium only under the following circumstances:

(a) When the tank desired is large (roughly speaking, exceeding the standard 30" x 18" x 13", twenty-nine gallon aquarium).
(b) When the need is for an aquarium with non-standard dimensions (for built-ins and sundry special applications).

The do-it-yourselfer would be hard-pressed to duplicate the quality and keep costs under that of the stainless-steel frame aquaria available from commercial sources. Very large and/or odd-sized aquaria are another matter, however, and here the aquarist may be able to effect considerable savings.

A growing number of aquarists, I find, are interested in the construction of a single, very large aquarium. To this end, I should like to describe the construction of such a tank (about 170 gallons) still in service in my own fish room, on a step-by-step basis.



1. The Frame:
The standard material for the frames of home-built aquaria is angle iron. Stainless steel angle can also be used but in large sizes, it is extremely expensive. Unless one has access to and is able to operate welding equipment (I am not), it is not practical or advisable to actually construct the frame oneself. What then to do? Prepare a sketch similar to Figure 1 (it need not be as fancy … a rough pencil sketch will do) and take it

The completed 170-gallon aquarium, as viewed by the author.

down to a shop specializing and equipped for welding. One can find such shops listed under "Iron Work" in the telephone directory. Explain that the finished product is to be used as an aquarium and request that special attention be given to the "trueness" of the rectangular shape and the lack of humps in the welded seams (especially on the inside of the frame). Different firms will give different estimates so it may pay to shop around. The 68" x 26" x 22" frame illustrated cost $35 (including materials, welding and painting with a rust preventive). Frames for smaller tanks have cost me as little as $12.50.

After the frame is received from the shop, it is advisable to paint the inside of the frame with asphaltum varnish. This is nothing more than asphaltum dissolved in naphtha, and is available from paint stores in quart and gallon sizes. Not all stores may stock this item, however, and it may be necessary to order it in advance. There are special roofing asphaltum compounds, loaded with asbestos fibers, but these of course, with the size and shape of the aquarium being considered, a 40-gallon tank of usual proportions would, for example, require 1/2" x 1/2" x 1/8" angle iron.

2. Sides and Bottom Preparation

If one uses nothing but glass, then no further preparation is necessary. But ½" plate glass is expensive, therefore I have long used waterproof plywood* for three sides and the bottom of my large tanks (40 to 200 gallons). For the tank pictured, the plywood used was ½". This plywood can be ordered ready-cut from your local lumber dealer.

Before "glazing" the plywood must be painted with asphaltum varnish. For safety's sake, paint both sides and the edges. This usually takes two days, first one side, and then the other. People are always amazed when I tell them that the "black stuff" is nothing more than waterproof plywood coated with asphaltum varnish! It is inexpensive and because of the nature of the material, lessens the chance of accidental breakage (plywood just doesn't break!). For most applications, only the front of the aquarium need be of glass anyway.

3. Glazing or Cementing

Cementing the glass and plywood into the frame is done in the usual manner. Due to the large quantity of aquarium cement needed, however, this may have to be ordered from your local dealer in 5 or 10 pound cans. Remember, the bottom goes in first, then the wooden sides, and lastly, the glass front. It helps to warm the cement before using (your oven will suffice but don't overdo it!). Cover the entire inside of the frame with a 1/8" layer of aquarium cement except for the very top half of the upper frame where the sides do not bear upon it.

4. Sealing

Fill the tank with water (do this on a concrete driveway!). It helps if the water is warm, but this is not necessary. The tank may leak much at first but once the water has gained some ground and has risen in the tank some, the water pressure will quickly seal all joints. Allow the tank to stand filled for a day or two, and then with a knife blade, remove excess cement that has been squeezed out around the frame. This cement may be reused on another project.

5. Wall treatment

After the tank has stood for a day or so and it has been confirmed that it is tight, empty it and allow it to dry. Now comes an interesting operation. Lay the tank down so that the long wooden side actually the back of the tank is on the floor. Again coat the inside face of this side with asphaltum varnish, but this time, make the coating extra thick. While the varnish is still wet (no hurry, it takes a number of hours for this), dump several bags of aquarium gravel on the wet surface. Spread the gravel around with your hands so that there is a layer of gravel about 1/4" or more on the asphaltum. Lightly pat the gravel down with you hands and allow everything to dry overnight. If you are careful, you will not get any asphaltum on your hands.

***Public aquaria often use pressed Masonite board (1/2" and 1" thicknesses) but use of this rather smooth material is expensive and would preclude the effects described in part 5).**

Shipping Fishes Via The Mails

[Aquarium Journal, June 1962]

So many aquarists have asked for details of what has turned out to be one of the most promising and fascinating aspects of our modern-day hobby, that this month's column will be devoted entirely to the subject of shipping small numbers of fishes through the ordinary mails. The subject is not to be confused with commercial shipments of fishes in quantity, via either air express or airfreight but is what I call H-H shipments (hobbyist to hobbyist). Such shipments basically involve nothing more than popping a pair or a trio of fish into a specially insulated container, trotting on down to the nearest branch post office, and mailing them! Properly prepared, such shipments have virtually a 100% live arrival rate and costs somewhere in the vicinity (on the average) of a dollar to send. The potential application for H-H shipments is enormous. A dwarf cichlid fancier in New York might exchange a pair of fish with another fancier in Texas, or a killifish fancier in New Orleans might exchange a pair

Figure 1. The container as it is readied for shipment. Note that the plastic bag containing the fish is well sealed to prevent leakage. Also, the corners are tied off with rubber bands to prevent crevices which would trap fish.

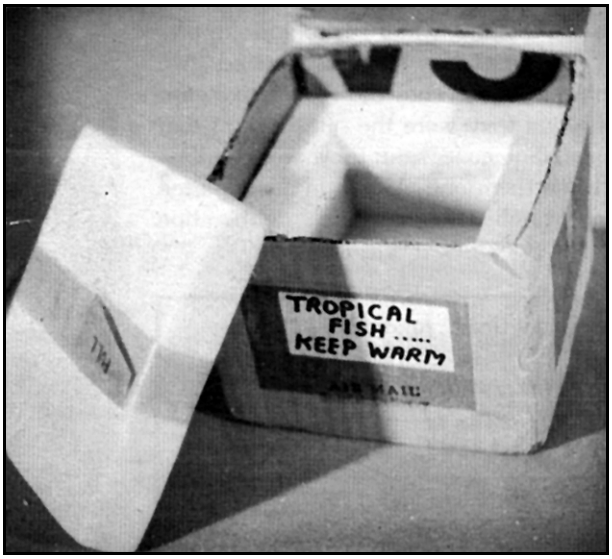


Figure 2. An inside view of the container, showing the polyfoam insulation and the hollow formed therein. The top slab is lifted out by means of the tab on it shown.

of fish with another in Pittsburgh. No longer need any fancier feel isolated in his hobby . . . all he needs is a few pen pals and the following procedural details:

A. The Insulated Container

In this day and age of wonder plastics, two expanded synthetics known as "polyfoams" are widely used and easily available. The first is polystyrene foam. Although it is available in colors, it is usually seen as a white, rigid material composed of millions of tiny airspaces or honeycombs. Christmas ornaments are often made of this material, as are model airplanes, novelties, etc. The highly expanded types are easily indented by the fingernail and can, of course, be sawed or even cut with a sharp knife. Polystyrene foam is also available in a pressed bead form. Many lightweight ice chests, for example, are composed of this material. Thus, you may procure expanded polystyrene in vastly different forms in a variety of places. A similar material, and one the author uses most often, is polyurethane foam. It is a bit more expensive but is a better insulator.

Polyfoam, then, forms the basic structure of the shipping container. A typical structure is constructed as follows: Procure a sheet of polyfoam, 12" x 12" x 1", and cut it into four identical pieces, 6" x 6" x 1". When stacked on top of one another, a sort of rectangular solid is formed. Now cut a square, 4"x4", from each of the two middle pieces or "slices." The block now contains a hollow, 4"x 4"x2," in which the plastic bag containing the fish is to be placed.

To protect the relatively soft polyfoam from damage, a cardboard box is built around the foam. It would be difficult to find a cardboard box already made to fit, and even then, such boxes would be needlessly heavy. The cardboard is held together by 2" wide masking tape. The completed container, which is strong, light, and rigid, is shown in the accompanying figures. The top layer of foam serves as a cover, and all that has to be done is:

(a) Place the bag containing the fishes in the hollow,
(b) Slip in the top polyfoam layer and
(c) Tape the cardboard cover to the box.

The box can be mailed as is or it can be wrapped in brown paper; however, the latter is not necessary. The resultant package is rigid and very light. Without the bag of fish, my containers weigh between 4 and 5 ounces! If your container weight exceeds this, you are wasting money in the form of added weight. After every shipment, the top cardboard square is usually replaced (because of all the stamps and addresses on it!), or else turned over for use another time. After about six H-H shipments, all of the cardboard is replaced with new, the foam, however, lasting indefinitely unless a safe falls on it somewhere along the line! A ready-made container is shown in the photos also. This is a beaded polystyrene container used originally for shipping delicate machine parts. It weighs only 2 or 3 ounces.

B. The Fish Bag

The fish to be shipped should be placed in a small plastic bag (use a double bag for safety's sake), 6" x 10", available at your dealer's (I purchase them from a local dealer for 50 cents per hundred). Two to five ounces of water will suffice for a trio of fish up to 2" in length. Twist the ends of the double bag and then bend the twisted end back on itself, fastening with two rubber bands. Then wind a piece of adhesive or plastic tape around the rubber bands. This may seem like a lot of extra trouble merely to ensure that no water will leak out, but wet insulation is poor insulation, and even a small amount of wet insulation is undesirable. Two small rubber bands are wound around the two corners of the bag so that the fish will not become trapped in them during the journey, and panic.

Before sealing the bag, two or three drops of tranquilizer per fish are added (I use "Metab-O-Fix") to the water. This reduces the oxygen demand upon the water by slowing down the metabolic rate of the fishes. It insures that the fishes will be able to make the journey safely in so small an amount of water. When sealing the bag, seal it so that there is an air space of a couple of cubic inches inside the bag. The complete package, ready to mail, weighs between 12 and 13 ounces.

C. Addressing

Other than the recipient's and you' own address (I place this on top of the container), nothing else is needed than a few inked labels marked, "Live Tropical Fish" (I place these on the sides of the container). This is to insure that the postman who delivers the package won't leave it on a cold doorstep should the recipients not be at home at the delivery time. The author's good friend, John Gonzales of Philadelphia, has tags printed for him bearing his name and address plus the legend, "Live Tropical Fish - Rush to Destination - Please Keep Moderately Warm." However, John makes many such shipments and ordinarily, such an expense would not be justified. My own inked labels are strictly freehand!

D. Shipping

Take the box down to the nearest branch post office (I usually get up 15 minutes early on the day I make a shipment, catch and box the fish and leave it on the kitchen table for my wife to mail after I have left for work ... on Saturday mornings, I mail it myself!) and have it sent out, AIRMAIL SPECIAL DELIVERY. This will cost from between 88 cents to $1.35 (these are actual expenses taken from my own records ... one shipment of 2300 miles cost me $1.35). A typical shipment is, for example, between Cincinnati and Chicago, and costs $0.92, including the special delivery charges. After making a number of such H-H shipments, one learns when the post office truck leaves for the airport and shipping is made accordingly. The post office and the postmen are fascinated by the whole business!

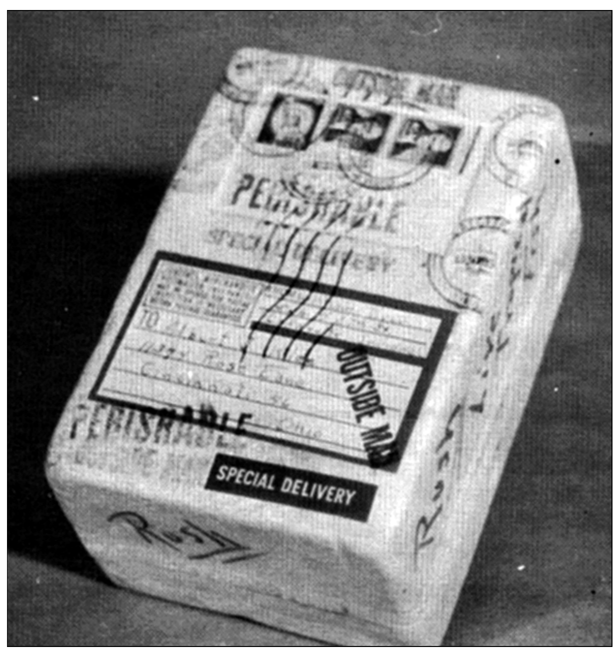


Figure 3. A ready-built container of 100% beaded polystyrene foam. This container, used originally for delicate machine parts, is rather soft but will last for many shipments. Its dimensions are 8" x 5" x 4".

E. Miscellany

It helps to forewarn the recipient of a shipment via a postal card. Delivery takes anywhere from 10 hours to two days, depending upon the connections between the two cities involved. From Cincinnati to Imperial Beach, California, trips average about 30 hours. Recipients are requested to send the container back as soon as possible via airmail (the box weighs so little that it wouldn't be worth while to use surface mail) unless a counter-shipment is expected.

F. Summary

To date, shipments have been made between Cincinnati and the following cities by the author: Chicago, New York, Kansas City, New Orleans, Imperial Beach (Calif.) and Lafayette (Ind.). Many aquarists have participated including Bruce Turner, Harvey Siegal, John Gonzales, George Maier, Gordon Foster, Bob Criger, Dick Stone, and Bill Dyer. We have all found it *very* effective and a real addition to hobby techniques. Many shipments were made in extremely cold weather and one shipment arrived in Cincinnati after four inches of snow fell a few hours before! For the cooperation of these aquarists, I am most grateful. Finally, our post office department certainly deserves a word of praise for the careful and expeditious manner in which they have always handled shipments. Try it yourself … it's fun!

Fluorescent Ballast As A Chill Breaker, Pronunciation Of Scientific Names

[Aquarium Journal, July 1962]

If you have ever touched the ballast (actually the ballast transformer) of a fluorescent lamp system, you probably have noted that it is quite warm. This heat is caused by eddy currents set up within the ballast and represents wasted energy. A Belgian aquarist, Monsieur A. Luytte of the Black Molly Aquarium Society in Kortrijk (like the Germans, Belgian aquarists frequently name their clubs for a popular aquarium fish), has "harnessed," so to speak, this wasted energy to serve as a chill-breaker or supplement to the normal tank heating system.

Basically the plan is to encapsulate the ballast with a non-toxic, waterproof container and suspend it in the aquarium water (see sketch for construction details). Our Belgian friend used lead sheet for this purpose but one could easily substitute a plastic container, for the heat evolved by the ballast would immediately be transferred to the water without danger of melting the plastic. Such a scheme might be useful also in the goldfish or native fish tank in order to prevent the temperature from going low enough to induce torpor in its inhabitants. In any event, aquarists who are "bugs" on efficiency might want to try this out!

Speaking of Belgium, I recently received a most interesting letter from the Belgian zoologist, Monsieur J. Lambert, a collaborator of Dr. Max Poll (Dr. Poll is an authority on the fishes of the Congo, having spent many years in research pertaining to these fishes), commenting upon the Beginner's Corner appearing in the February issue (1962) of the *Journal* ('Pronunciation of Fish Names'). I quote in part from his letter:

"The pronunciation of the final "i" of Latinized names as EYE," seems to be current in English-speaking countries. However, this pronunciation is most shocking to us Continental Europeans and especially to those speaking a language more directly derived from Latin! Indeed, the final `i" in French or, Italian, for instance, has always the phonetic sound of our "EE" sound, or per haps a somewhat shorter sound, like in 'Cincinnati'."

He goes on to say that it is reasonable to assume that the French or Italian pronunciations are closer to the original Latin than the English pronunciation. In this, I quite agree. There are two widely used systems of scientific name pronunciation used in the world today: the "English method" (which I used in my article) and the "Continental" or "Roman method." The English method dates back to the days when it was widely used in English courts of law. From there it appeared next in English and American schools. There is a movement now to supersede it with the Continental pronunciation, which is taught in European schools and in some secondary schools and colleges in the United States. However, most biologists in England and America have been weaned on the English method, as have aquarists, and I am not certain as to which conversion will come first in America, inches to centimeters, or the English method to the Continental method!

Incidentally, M. Lambert corrects an error in my February Beginner's Corner re the pronunciation of *Aphyosemion schoutedeni.* If the Dutch pronunciation is desired, it should be, **S'**-HOW-TE-DEN-EYE. However, M. Lambert, who knows Dr. Schouteden personally, passes on the interesting information that like many Belgians with Dutch names, he prefers to pronounce it in the French way so that it should be pronounced, **SKOO'**-TE-DEN-EYE.

There have been a number of very fine aquarium plant articles appearing in the literature lately but, I am sorry to say, the outdated plant nomenclature commonly used slightly mars their overall effect. The generic terms, *"Anacharis"* and *"Ambulia,"* for example, are properly relegated to use now only as popular names as the correct scientific names are *Elodea* and *Limnophila,* respectively. In this, the situation somewhat parallels that of the use of "panchax" in the fish end of things. Authors writing about aquarium plants are advised to utilize the inexpensive and very excellent, "`Manual of Aquarium Plants," published by Shirley Aquatics Ltd. in England. Mr. C. D. Roe, a director of Shirley's, has informed me that a new edition is planned for 1963, in which there will be several additions to *Cryptocoryne* and others. Incidentally, Mr. Roe is quite anxious to obtain specimens of *Elodea naias* Caspary (a plant from Brazil and Paraguay), and if any reader is cultivating this plant presently, I would very much like to hear from you in care of the *Journal.*

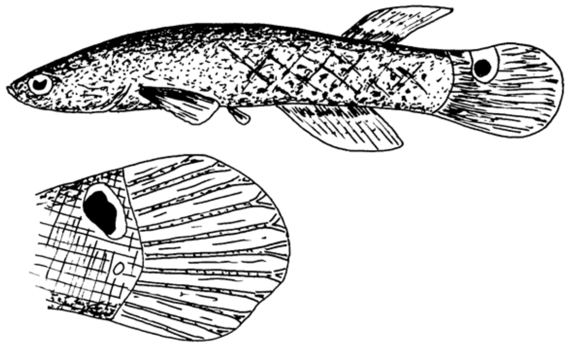
***Living in Cincinnati as I do, I cannot refrain from the ironic observation that although non-Cincinnatians pronounce this word, "SIN-SIN-AT'-TEE," many native Cincinnatians pronounce it, SIN-SIN-AT'-A!**

Rivulus marmoratus

[Aquarium Journal, October 1962]

Many aquarists think of members of the genus *Rivulus* primarily as tropical fishes, inhabiting mostly portions of the South American continent. Its northernmost member has generally been considered to be *Rivulus cylindraceus,* originally from Cuba, a fish widely used in the aquarium and considered as an excellent beginner's killifish. A recently recognized (1958) component of the continental North American fish fauna, however, is *Rivulus marmoratus.* It has been found in Florida as well as in Cuba and the Bahamas. A subspecies, *Rivulus marmoratus bonairensis,* has been described as originating in parts of the Netherlands Antilles (Curacao, Bonaire, etc.) in the West Indies. From time to time, this species has been misidentified as *Rivulus cylindraceus,* leading to erroneous reports that the latter is native to this country.

Rivulus marmoratus is not one of the more brilliantly colored members of the genus, by any means, but it does sport an interesting pattern of markings. Its body coloration is a deep maroon, tending towards pale reddish brown. It is, as might be expected, darker on the top and lighter on the bottom, shading from a dark



***Rivulus marmoratus*, showing an alternate ocellus (below) located at the base of the fin. Sketch by the author.**

brown to a pale cream. Diffuse, light buff blotches on the sides of its body give it a checkered appearance (see figure). These markings are arranged in diagonal rows and there is a random scattering of red-brown to blackish dots over the rear lower portion of the body sides. The unpaired fins are mottled in a more or less regular pattern of small dots. In general, both sexes are colored alike except for dark edging to the dorsal and anal fins of the males. Both sexes display, however, the well known "rivulus spot" at the base of the tail. Usually it is the female only that carries this caudal ocellus but in a few species of *Rivulus,* both sexes display it *(R. ocellatus,* for example, and the young of a number of other species). In length, the fish will vary between about one and three-quarters to two and a quarter inches.

Rivulus marmoratus has been taken from the Indian River, Florida, from 6 miles north to 6 miles south of Ft. Pierce Inlet. Luckily for me, my parents live about a mile from this collecting spot and are now in the process of obtaining specimens for me. Collections have been made in anti-mosquito ditches, traversing mangrove swamps (black mangrove, *Avicennia nitida)* and within 200 to 850 feet of the shoreline of the Indian River. However, in these ditches where the fish were found, vegetation was absent except for a bottom covering of mangrove leaves. The water itself was malodorous with a marly muck bottom. In addition, it was turbid to opaque. The water is brackish and the temperature was in the high 80's to low 90's, even though the ditches were shaded by the mangroves. A dissection of a number of specimens showed a stomach content of crabs, snails, and mosquitoes. This was not the only fish present here, by the way. *Fundulus confluentus, F. grandis,* and a number of non-killies were present also in numbers.

That *Rivulus marmoratus is* the only *Rivulus* in the U. S. would be reason enough to discuss it; but it has an even more important claim to fame than this. I invite the reader's attention to Dr. Atz' excellent article in the October 1961 issue of the JOURNAL entitled, "Fish Without Fathers," in which he discusses the unusual, almost all-female species of livebearer, *Mollienesia formosa* (the Amazon molly). In effect, this fish has "fatherless" offspring, although males (of other species of *Mollienesia* since males of *M. formosa* are rare critters, indeed, are needed to trigger development of the egg. In any event, the offspring carry only the genes of the mother.

Dr. Harrington at the Entomological Research Center in Florida recently discovered that adult specimens of *Rivulus marmoratus* in his care, even if isolated from all other fishes, laid eggs that hatched out into fish just like the mother! The situation is reminiscent of the Amazon molly except that no males are needed. Indeed, Dr. Harrington could find no true males in his collection (several suspect males are being examined now … males are certainly known in the subspecies previously mentioned), the presumed females being truly hermaphroditic. From a single fish, a fry was obtained which when adult (6 months later) produced an egg which also yielded a fry, which in turn produced eggs four months later! Thus, progeny was obtained via a selfed great grandparent,

grandparent and parent. There was no question of bisexual activity since each egg was isolated from the day of hatching, and the fry were isolated also. This development has significance for science because it adds a highly homozygous (i.e., an animal containing one or another but not both, of at least one pair of alternative, contrasting Mendelian characteristics) strain of fish to the few now available (the Amazon molly and a few other fare livebearers being the others in the aquarium world). With this fish, it may be possible for scientists to study transplantations of organs, tumors, and other tissues with possible beneficial consequences to man himself.

There is more to the story of *Rivulus marmoratus* such as the possibility that it is to some extent, ovoviviparous, a term applicable to most of our aquarium livebearers and signifying live delivery of young without the intimate contact between mother and egg that characterizes true viviparity. Thus, the connection between killifishes and common livebearers may be shown to be closer than previously thought. It is always of interest when an aquarium fish makes scientific headlines and *Rivulus marmoratus* is triply deserved of the honor.

Neolebias ansorgei, "Water Pine"

[Aquarium Journal, November 1962]

In an article in the East German aquarium magazine, AQUARIEN AND TERRARIEN, Helmut Stallknecht brings up a point that should interest all hobbyists attempting to disseminate knowledge of their first-hand experiences. Mr. Stallknecht first observes that in reading breeding reports, one often finds statements like, "Spawning took place in the typical tetra manner," or, "The fish, after a vigorous display of pre-nuptials, spawned among the fine-leaved plants," or, "Spawning is stormy . . . both fishes pressed their bodies together and after a short time, separated again to continue later." Actually, such sample descriptions really tell the reader little. If we are to consider the "typical tetra manner" of spawning, what tetra are we to consider? The tetra von rio *(Hyphessobrycon flammeus)? Copeina arnoldi?* The neon tetra? The swordtail characin *(Corynopoma riisei)?* These are all "tetras" but they definitely do not share the identical spawning characteristics. In order not to be in the position of one who criticizes without also making a contribution at the same time, Mr. Stallknecht describes the spawning of the pretty little African tetra, *Neolebias ansorgei.* I will, because of space limitations, briefly summarize these observations, such observations serving as a guide to future reporters in our own literature.

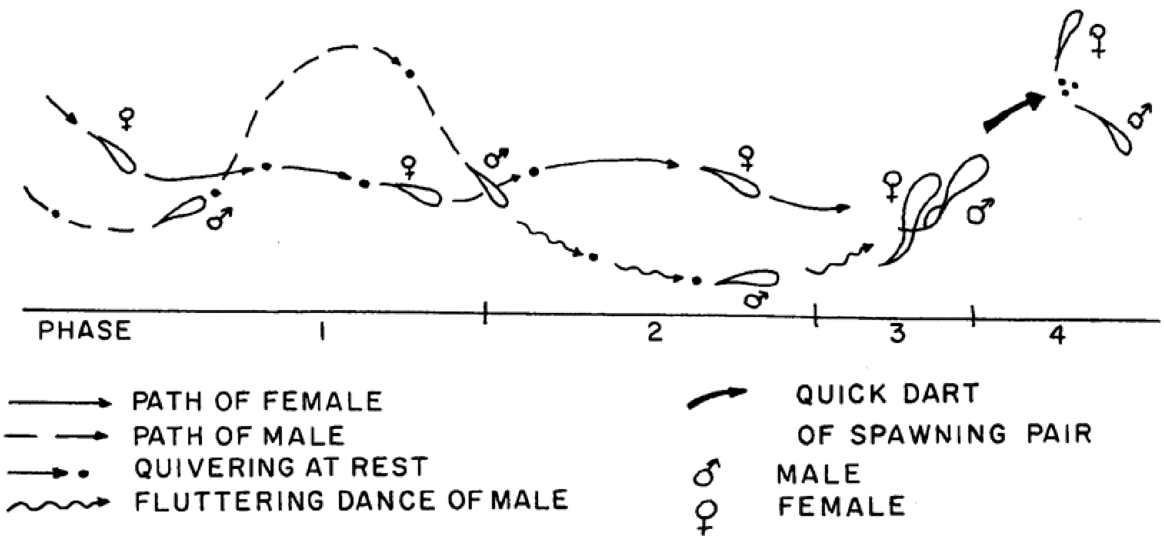
The spawning of *Neolebias ansorgei* takes place in four phases as follows:

Phase No. 1: The male first swims around the female in a sort of zigzag dance. Should the female decline to evince any interest, the male rams the female in her side.

Phase No. 2: The female now follows the male a short distance back while the male does a fluttering strut in front of her. Should the female not follow, phase No. 1 is entered into again.

Phase No. 3: Now the female comes up even with the male so that her mouth is about even with the sexual opening of the male. The male curves his tail behind the sexual opening of the female, and at the same time, forms a pocket with his anal fin that is extended towards the female. Both fishes are bent into an "S" shape. In this manner, the eggs and the sperm are expelled. The pocket formed by the male's anal fin serves as a fertilization "chamber," ensuring the highest possible incidence of fertile eggs.

Phase No. 4: With a strenuous motion, the fish dart forward into the plants an inch or so, and then separate. After approximately three min-



Spawning behavior of *Neolebias ansorgei* (after Stallknecht)

utes have elapsed, the fish enter into phase No. 1 again. The complete cycle is nicely shown in the accompanying diagram.

This is reporting as it should be and we would do well to hold it up as an ideal or guide.

Killifish fanciers have always had trouble in finding reasonably correct scientific names for the series of fishes, *Aphyosemion arnoldi, A. gardneri, and A. filamentosum.* It has generally been accepted that by far the commonest visitor to our shores is the last-named, with the middle fish ranking a distant second. As for *Aphyosemion arnoldi,* it is doubtful whether a half dozen aquarists in this country have ever seen the fish. Last year the author's friend, Ulf Hannerz of Sweden, made an expedition to Nigeria and during the trip, discovered what later appeared to be the true *Aphyosemion arnoldi.* The fish has been examined by one of the famous ichthyologists of Denmark, a scientist quite familiar with West African killifishes. Although work remains to be done on the classification of this fish, it differs but slightly from Boulenger's original description. A photograph of *Aphyosemion arnoldi* captured in the vicinity of Port Harcourt, Nigeria, is presented for our readers' examination. At first, it will appear to be a cross between *Aphyosemion filamentosum* and *Aphyosemion walkeri,* however this true *arnoldi is* much larger than *A. walkeri* (which, after all, is practically a dwarf species), and its tail differs considerably from that of *A. filamentosum.* In the September 1959 issue of the *Journal,* I pictured Boulenger's drawing of *Aphyosemion arnoldi* modified after an old drawing gleaned from a German catalog of years ago. It appears that I should have stuck with Boulenger, as his drawing is mighty accurate! One of the odd characteristics of the true A. *arnoldi* is the spread caudal fin. Only in *A. walkeri is* this characteristic as evident.

It is always a pleasure to pick up a copy of the Aquatic Researchers of San Antonio's monthly bulletin, AQUA-FOCUS, edited by the charming and talented Mrs. Leona V. Bradley. Mrs. Bradley is a one-woman powerhouse and her magazine frequently "scoops" the more elaborate commercial magazines. A recent issue discussed an instance in which aquarists quite obviously have had the proverbial wool pulled over their eyes. This concerns the sale of an unusual plant called, "water pine," as an aquatic plant. If you have never seen this plant, it is a miniature replica of a branch of a shortneedled pine tree. At first glance, it is very handsome and would appear to be a welcome addition to the aquarium. Mrs. Bradley, however, smelled a rat and asked for Mr. Albert Greenberg's opinion on the plant. Mr. Greenberg, who few know is a qualified Plantsman and not merely a grower of aquatic plants and a fish farm proprietor (although his fame is truly deserved here, also), announced that the plant was a complete fake as far as an "aquatic plant" went. Quote Mr. Greenberg: **"It's just pieces of various terrestrial pine trees. Sometimes they survive for a short time under complete submersion but before long, they die and do mess up the whole works."**

I feel that those who sell such items to uninformed aquarists are cheating their customers if they do not explain the facts clearly. There is nothing basically wrong in experimenting with terrestrial plants in the aquarium … I myself have used *Philodendron, Sansevieria* and *Caladium* in my aquaria with some satisfaction. Their stay in the aquarium wasn't long, but it was a pretty sight while it lasted. It is, however, nothing for the beginner to be burdened with, especially without warning of the lethal characteristics of these land plants in the aquarium. Too many fish may be lost overnight because such plants suddenly decomposed. For publicizing this example of unethical practices, Mrs. Bradley deserves our thanks.

Book Reviews, Whitley, Reichenbach-Klinke, Jubb

[Aquarium Journal, December 1962]

This month is "Book Review" month for our column, a very infrequent occurrence indeed due to the paucity of aquarium literature that comes by the average aquarist's desk in this country. As a matter of fact, the books to be discussed shortly are not all strictly written for aquarists but what they may lack in specific direction to our field, they more than make up for in content valuable to the aquarist. If you are like me, then you are a bibliophile and an especially avid one when it comes to books dealing with fishes. In addition, I get a sort of muted pleasure out of the fact that the trio of books to be discussed were published in Australia, Germany and South Africa, respectively, and what more can one offer to point up the cosmopolitan aspects of our hobby?

A rather tiny book vis-à-*vis* American standards is *Freshwater Fishes of Australia*, written by the well-known Australian ichthyologist, Gilbert P. Whitley. It is available for the sum of $1.85 from the Jacaranda Press Pty. Ltd, 73 Elizabeth St., Brisbane, Australia. Although it contains a good deal on game fishes, there is much to interest the aquarist, especially in view of the fact that information regarding Australian aquarium fishes is hard to come by normally. For example, American aquarists are generally familiar only with one species of glassfish, viz., *Chanda lala,* but Australian aquarists know many more glassfishes than this one. As a matter of fact, however, our counterparts "down under" have, according to Whitley's classification, five freshwater genera of Chandidae (glass fishes) to choose: *Austrochanda, Blandowskiella, Priopidichthys, Denariusa* and, of course, *Chanda.* Examples of all of these are discussed in Whitley's book. Don't be envious but there are three species of archer fishes *(Toxotes)* there also. I was quite interested in learning that a primitive sort of archer fish, *Protoxotes lorentzi,* is found in the Northern Territory and New Guinea. Seems that we may expect many new and strange fishes to arrive in our tanks from Australia within the next few years. *Protoxotes,* although not as prettily marked as the more familiar archer fish, reaches a length of only 5-1/2 inches so is a candidate for our tanks just the same. Whitley writes at a level very suitable for the average aquarist, and the supplemental information provided at the beginning of his book on how a fish is described, provides a welcome non-technical explanation of an otherwise complicated subject. A book recommended for the aquarist specializing in the silversides and related fishes as well, *Freshwater Fishes of Australia* is well worth its token price.

A more ambitious project and, unfortunately for most of us, written in German, is Dr. Reichenbach-Klinke's *Krankheiten der Aquarienfisch* (available from Alfred Kernen Verlag, Stuttgart W, Schloss-Strasse 80, Germany, for the sum of $4.30). It is a far more professional work than van Duijn's *Diseases of Fishes* and for aquarists having a working knowledge of German, the book is a "must." For those not familiar with German, the English translation of the title is, "Diseases of Aquarium Fishes," and the book is enticingly subtitled, "With Special Reference to Tropical Species." Dr. Reichenbach-Klinke sticks to this subtitle closely and many examples of diseases are given with familiar aquarium hosts. To name just a few: *Mycobacterium piscium* on *Xiphophorus maculatus, Ichthyosporidium hoferi* on *Betta splendens, Clinostomum complanatum on Colisa lalia,* and *Livoneca symmetrica* on *Carnegiella strigata.* If the first of each one of these pairs sounds new to you, they are parasites and no one will blame you if you don't know them for American aquarists are seldom supplied with information regarding the sundry diseases of aquarium fishes that is provided in this book.

An especially nice feature of *Krankheiten der Aquarienfische* is its many illustrations, including microphotos, photographs of infected fishes, and excellent line drawings. In a few places, the nomenclature used for fishes is dated, and perhaps the nomenclature used for these disease-producing organisms does not quite coincide with established American microbiological usage, but this does not detract from its value to the aquarist. If there ever was a reason for aquarists learning German, Dr. Reinchenbach-Klinke's book is it!

Our last candidate for the aquarist's bookshelf is Jubb's, *An Illustrated Guide to the Freshwater Fishes of the Zambezi River, Lake Kariba, Pungwe, Sabi, Lundi and Limpopo Rivers* (available from Stuart Manning (Pvt) Ltd., Box 1305, Bulawayo, Southern Rhodesia, for the sum of $6.90). Yes, the title is a mouthful but the book's content more than made up for that! For cichlid fans, there are a number of color drawings done by the author's wife but many other fishes are illustrated, not only in color drawings but also in black and white photos and wash drawings. The author is Research Assistant in the Department of Ichthyology, Rhodes University and is well qualified to write such a book. The really pleasant surprise is that the author has not overlooked the aquarist and his descriptions are very readable. At the end of the book are a number of lists of fishes suitable for the aquarium, arranged according to size. For killifish fanciers, for example, *Nothobranchius orthonotus, Micropanchax johnstonii,* and *Micropanchax myaposae* are among those recommended for the small aquarium. Photographs of these fishes are supplied. Since information on African fishes is also hard to come by, and since this book deals with an area even less seldom treated, the great value of it becomes apparent. A number of issues ago, a reader of the JOURNAL requested more detailed information on the genus *Labeo*… well, here is one excellent source! Especially interesting is a discussion of the hydrobiological aspects of the area concerned. To the aquarist, this is nothing more than a natural habitat study and the information contained within should fill in one more of the hitherto unknown notches in the race to learn more about breeding our "problem fishes."

If you should order any of these books (the prices I quoted include postage), prepare for a long wait since they travel strictly via steerage. The distances involved are far too great to permit airmail to be used. If you are a serious aquarist, or just plain like to read about fishes, then the money is well spent on any or all.

Barbus candens, Lake Inle Fishes

[Aquarium Journal, January 1963]

For those aquarists who like to ask, "What's new?" our answer this month is three new, most unique aquarium fishes. All of them are cyprinids (which is to say, fishes related to the barbs, rasboras, danios and goldfish) and so should remove any doubt that this column plays any favorites as far as fish are concerned!

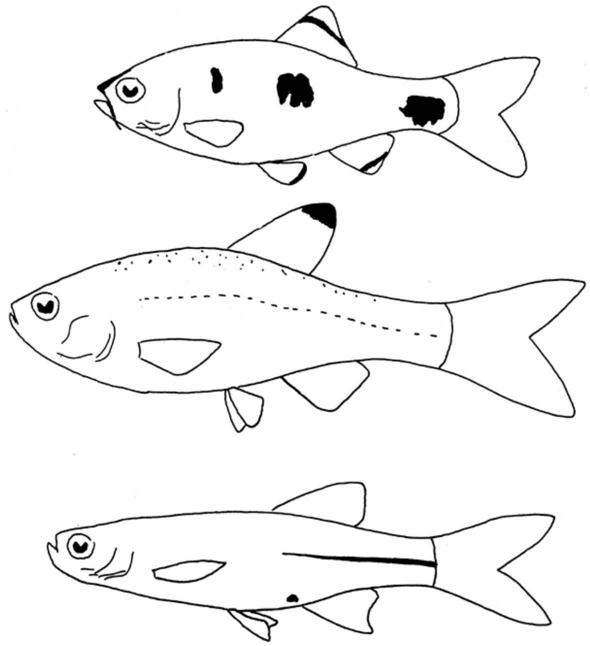
Our first fish is *Barbus candens*, described by Nichols and Griscom in 1917. Truthfully, this is one of the prettiest dwarf barbs to come into the hands of aquarists (males are about 35 to 40 mm, and since there are 25.4 mm to the inch, one can see that this fish really is a dwarf)! A quick glance at the drawing might result in the comment, "Oh, the butterfly barb, *Barbus hulstaerti*!" It is true that these two fishes resemble each other very closely; in fact, one of the first articles written about *Barbus candens* appeared in the Belgian aquarium! magazine, AQUARIUMWERELD, and was titled, "'n Kongolees Probleem Opgelost" (meaning, "A Congo Problem Solved." My Belgian friend, Jacques Lambert, who at first was puzzled by the resemblance to *Barbus hulstaerti*, listed four points of difference between the species in this article:

(a) In *B. hulstaerti*, the 2nd body spot is much larger than the tail spot. In *B. candens*, they are about equal.
(b) In *B. candens*, the tail root spot lies mostly below the middle of the root while in *B. hulstaerti*, this spot lies roughly in the middle.
(c) *B. hulstaerti* lacks the black edging to the snout that is a feature of *B. candens*.
(d) The dorsal band in *B. candens* remains somewhat narrow, but in *B. hulstaerti*, this becomes quite broad.

If you should obtain some of these fishes, don't confuse them with *Barbus hulstaerti* then. Check the above list carefully to determine which of the two species you have.
In general, *Barbus candens* has a rose red coloration, tending to brownish gold on its back and more white (but still rosy) on its belly surfaces. The gill covers are so transparent, that the blood that flows through the gills is clearly seen, and this part of the fish is literally blood red. The large, black spots stand out most vividly against the rose red background. There is a dark band in the dorsal, and the pectorals and ventrals are bordered in black.

Barbus candens comes from the shaded jungle creeks of northern Congo, in water, which is brown and acid (from 0 to 1 DH, and about a pH of 5). In this natural habitat, there is so much humus debris on the bottom that plants are usually absent, except for those plants, which grow along the shoreline. This, perhaps, accounts for one of the strangest breeding methods observed among the barbs … *Barbus candens* lays its eggs in the bottom layer much like the bottom spawning aphyosemions! Unlike other barbs where the eggs hatch within 24 to 36 hours, the eggs of *Barbus candens* incubate for about a week, after which they hatch. Unlike other barbs also, and more like the soil breeding aphyosemions, egg production is limited, somewhere around 30 fry resulting from the average spawning. The analogy between *Barbus candens* and these aphyosemions is most interesting. Is it possible that killifish fanciers have been fooling themselves all these years?

The usual explanation for the soil breeding act in the bottom spawning aphyosemions is that this is the manner that eggs are protected during dry periods. But it is known that some soil breeders inhabit areas, which do not dry up. What use is soil breeding then? Perhaps the answer is the one that seems appropriate for *Barbus candens* ... that soil breeding occurs



FROM TOP TO BOTTOM: ***Barbus candens*** **Nichols & Griscom;** ***Sawbwa resplendens*** **Annandale;** ***Microrasbora rubescens*** **Annandale. Sketches by Albert J. Klee**

because of a lack of plants. That a shaded jungle pool could be devoid of plants might be a difficult thing to grasp, but Africa is full of just such water types. It is, in any event, something to reflect upon.

In the AQUARIUM JOURNAL for 1952, Dr. George S. Myers wrote about a little known work by N. Annandale titled, "Fauna of the Inle Lake." This was a monograph written in 1918 concerning the Inle Lake in India and as Hermann Meinken writing in a recent issue of DATZ commented, "It's been a long time!" But long time or no, the very fishes that Dr. Myers suggested might be future aquarium fishes have now appeared upon the hobby scene. In particular, the fishes referred to are (and these will be quite new to aquarists) *Swaba resplendens* and *Microrasbora rubescens.* Incidentally, I might digress here to remind readers of the *Journal* that Dr. Myers, in the series of articles that contained the reference alluded to, predicted far into the future about what our future aquarium fishes might be. In his series called, "Hints to Fish Importers," he pointed out that importers might do well to bring in specimens of *Nematobrycon palmeri* and *Nematobrycon amphiloxus.* As we know, 8 years later in 1960 (Dr. Myers' series was written in 1952), the first of these species was imported as an aquarium fish, and a year later, the former was also. Congratulations to Dr. Myers for his foresight!

Returning now to Lake Inle, we of serve that it is a most peculiar lake. 1 some respects, it resembles the strand Lake Tanganyika in Africa in that harbors some unusual fishes and is somewhat hard water lake. It normal contains about 171 ppm of dissolve solids, a third of which are calcium and magnesium salts. For tropicals, this is hard water indeed and not at all the kind of water we usually expect. The lake itself is rather shallow, averaging about 6 to 7 feet in the dry season, and about 18 feet during the rainy period. It is important to note that the two species to be described are beautiful fishes *only* if kept in relatively hard water. In so water, they lose much of their coloration.

The genus *Sawbwa is* related to the genus *Barbus;* however, it has no scales on its body! Roughly, it resembles the bitterling *(Rhodeus)* but it is far more colorful. The body is basically a steel blue, with belly areas tending towards silver white. There are great numbers of fine, black spots on the back with a greenish halo about them. During spawning, the males show bright orange red to scarlet red breast parts, gill covers, lower portions of the head, anal and tail fins. This contrasts nicely with the overall blue sheen. We are, of course, referring now to *Sawbwa resplendens,* imported both by Dutch and American firms just recently. The sexes are easily distinguished since the fullness of the female's body is quite apparent. Both sexes, however, sport dorsal fins with black tips.

Our last candidate for the "What's new" category this month is *Microrasbora rubescens.* The genus lies somewhere between *Rasbora* and *Danio* and as Herr Meinken remarks, the species in question resembles a half grown *Rasbora dorsiocellata. Microrasbora,* however, has no barbels. The species is bluish silver and has a dark, narrow stripe from about the middle of the body (just under the beginnings of the dorsal fin) to the tail fin, situated about in the middle of the body halfway between dorsal and ventral surfaces. There is a distinguishing black spot near the beginning of the anal fin and during spawning the males take on an intensive scarlet red coloration. In both sexes, the sides and the lower portions of the head, as well as the vertical fins, are a pretty red color. Both *Sawbwa resplendens* and *Microrasbora rubescens* are dwarf species, averaging a bit over 1 inch in standard length. The meaning of their names is as follows:

Sawbwa: after a native name *resplendens:* shining with brilliant luster, referring to the bluish sheen.
Microrasbora: small rasbora.
rubescens: reddish, referring to the vertical fins, head, gill covers and body.

Direction of Spawning, Overfeeding - *Proteus vulgaris*

[Aquarium Journal, February 1963]

In this column for November 1962, we mentioned the highly detailed and excellent observations made by a German aquarist, Helmut Stallknecht, during the spawning of *Neolebias ansorgei.* Mr. Stallknecht's latest work provides additional food for thought and suggests perhaps that similar work be done by American aquarists to either refute or reinforce his conclusions. In observing the prenuptial play of the flame tetra, *Hyphessobrycon flammeus,* it was noticed that the fish (a male and a female) came together in actual body contact, and then proceeded to swim in a circular path, In all cases, the motive power for this motion came from the male whose position was on the outside of the circle. The female "went along for the ride," so to speak, by hooking her ventral fins alongside those of the male.

Now it was also noticed (in the course of experimenting with many pairs of fishes) that sometimes the direction of motion of the pair was clockwise, and at other times, counterclockwise. It was in trying to find out the reason for this that Mr. Stallknecht observed that when a female was heavy with eggs, the resulting rotundity of her body was not distributed equally on both sides. This is the way that a decided bulge was noticeable on either her right side or on her left, but usually never on both sides at once. This was most clearly seen when observing the fish from above. Finally, it was discovered that females "heavy" on the right side, i.e. "right heavy" always took a counterclockwise path with the male, and "left-heavy" females in a clockwise path. A consideration of the geometry of the situation (see sketch) shows that this choice of path provides the maximum proximity of the side of the female's body containing the eggs, to the body of the male. If the direction were opposite to what I have indicated, the female's body would bow in the wrong direction and apparently lessen such contact.

This is not the only species in which this rule has been observed. It has been demonstrated in *Copeina arnoldi,* also. Aquarists have long known that there are "right" and "left" spawning pairs in certain livebearers (e.g., in *Anableps* where any single female's genital opening can only be approached on the right or left side by a male and consequently, must mate with a left or right oriented male, respectively). This is most definitely a result of mechanical requirements. It would be interesting

LEFT: Top view of a counterclockwise-circling pair. Results when female's egg mass lies on her right side. RIGHT: Top view of a clockwise-circling pair. Results when female's egg mass lies on her left side.

to see if this sort of contact, in which the male contacts the heavy side of the female, occurs in other species of egg layers also.

Recent experiments indicate that overfeeding and pollution of fish tanks may harm or kill at least some kinds of fishes in a way additional to suffocation. A common bacterium found in the aquarium is *Proteus vulgaris.* Its name is derived from the fact that it is common *(vulgaris* means common) and that it is a consumer of proteins. The Japanese team of Moriyama and Ueno investigated the effects of this bacterium on young medakas, *Oryzias latipes,* and made the following observations:

1. When a suspension of ground fish was added in sufficient quantity to an aquarium containing medakas, the medakas died. Their deaths were attributed by the Japanese scientists to *Proteus vulgaris.*

2. The same result was observed when either peptones (an artificially made partial decomposition product of proteins, useful in culturing certain bacteria) or trypsin-digested casein (also used as a nutrient in bacteria culture, casein being a protein derived from milk) was added to the aquarium. Again, the deaths were found attributable to *Proteus.*

3. *Proteus,* however, did not directly kill the fish. This bacterium is harmless, but during its reproduction, it produces a substance, which is lethal to fishes. The production of this lethal factor was not, as might be supposed, directly proportional to the growth of the bacteria.

4. Different amino acids added to the aquarium (organic compounds often called the "building blocks of proteins" but also produced in the decomposition of proteins) did not hinder the production of this toxic factor. Other decomposition products such as polypeptides in particular, were transformed by the nitrogen-conversion abilities of the bacteria into this lethal factor.

5. The production of the toxic factor increased as the temperature was increased.

6. When the medakas were exposed to a sub lethal dosage of the toxic factor, and then two days later brought up to a lethal dosage, they died just as control fish died that were not "pre-conditioned" with a sub lethal dosage.

7. It was observed that the production of the toxic factor was enhanced when shallow glass Petri dishes were used instead of the usual test

tubes as containers for growing *Proteus* and producing toxic factor.

What do these findings mean to the aquarist? They demonstrate, for one thing, one of the types of dangers of overfeeding. Fish foods represent a source of proteins in the aquarium. It is interesting to note that *Proteus* itself, acting on the fish, was not responsible for the deaths, but rather a toxic substance produced *only* in the course of its reproduction. It is not necessary, therefore, to use a bactericide (i.e., a substance that destroys bacteria) since a bacteriostatic agent (i.e., a substance which inhibits the growth of bacteria without destroying them) would accomplish the objective of halting the rapid multiplication of the bacteria, and hence stop the production of the lethal factor.

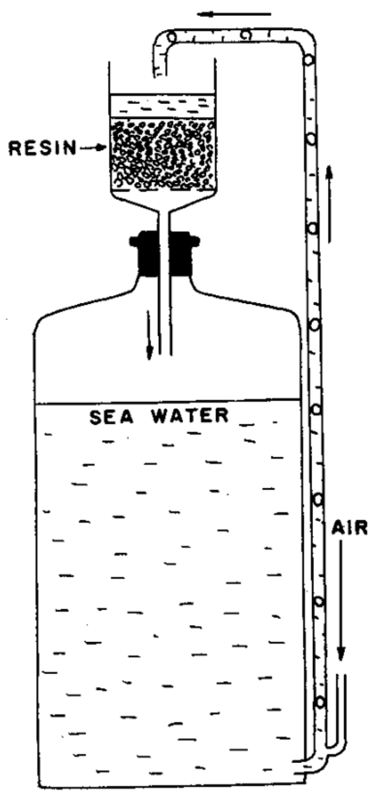
It is interesting to note also that no tolerance to the toxic factor could be induced. The medakas apparently could not gain any resistance to the toxic factor when it was administered in less than lethal dosages. The effect of temperature would be anticipated by most experienced aquarists, so this result is not surprising. Overfeeding, then, can perhaps result in a complicated interrelation of effects, starting first with accelerated reproduction of normally harmless bacteria. Tremendous numbers of these organisms can actually cloud the water, the food particles themselves not being responsible. Many experienced aquarists have seen this condition in beginners' tanks. Along with this accelerated reproduction, the bacteria break down proteins and produce a toxic factor. As remedial action, strong aeration is a partial answer. Remember, however, that one must stop the further reproduction of the bacteria and aside from using a bacteriostatic agent, the excess protein (i.e., uneaten food) must be removed, or at least no more be added. Since the toxic factor remains for a while, a partial change of water is indicated in severe cases.

Amazon Heart Sword, Nitrates, Artificial Parents

[Aquarium Journal, March 1963]

In the October and November 1962 issues of the JOURNAL, LeRoy N. Phelps discussed a new plant, which, for lack of proper scientific identification, remained somewhat of a mystery nomenclaturally speaking. Popularly, however, the plant is known as the "Amazon heart sword." Mr. Colin D. Roe of Shirley Aquatics in England (author of *Shirley's Manual of Aquatic Plants*) has kindly provided an authoritative opinion on this matter and it appears that its correct scientific name is *Echinodoras tunicatus* According to Mr. Roe, it is the only species described in Fasset's monograph on the genus as having the achene (a small, dry, one-seeded fruit which ripens without bursting its thin outer sheath) completely enclosed in the sepals. Shirley has cultivated the plant for about four years and has found this to be the case. Incidentally, Mr. Roe also shares Mr. Phelps' high opinion of this species, finding it to be one of the most satisfactory members of the genus for aquarists. Our thanks to Mr. Roe for this detective work!

Marine aquarists have long recognized the problem of buildup of nitrogen compounds in the saltwater tank. In the aquarium, nitrates are the oxidation products of various organic materials among which are uneaten food, fish excrement and urine, and various microorganisms. Even well managed marine aquaria contain perhaps three to six times the normal amount of nitrogen found in sea water (natural sea water will contain, depending upon conditions, up to one ppm of nitrate) and old, established aquaria are frequently found containing up to ten ppm of nitrates. This is an unnatural condition imposed upon marine fishes for in their native habitat, natural nitrogen-absorbing materials keep dissolved nitrates down to much lower levels. Over the long run, excessive nitrate content affects marine fishes ad-



Experimental apparatus for testing the new nitrate-removing resin.

versely, apparently reducing their resistance to diseases and probably decreasing their life-span. Unfortunately, ordinary marine filter materials such as charcoal, chalk. etc., do not remove dissolved nitrates from salt water. Recently, however, the chemical industry has been able to manufacture very selective ion-exchange resins, similar to those used for removing calcium and magnesium from fresh-water aquaria, but which remove nitrates from salt water. Karl Bohnen, writing in DATZ, experimented with just such a resin as follows.

In one liter (about a quart of nitrate-free salt water) he placed 0.8 grams (for comparison, a dime weighs about three grams) of fresh, killed mussel flesh (experiment A). The water was circulated, via an airlift, through some of this new filter resin (see sketch). In experiment B, the same conditions were duplicated except that activated charcoal was used in place of the resin, and in experiment C, no filter medium was used at all although the salt water still was circulated in the same kind of apparatus.

After one day, flask A was clear, B was slightly cloudy, and C was very cloudy. After four days, A was insignificantly clouded, B was more strongly clouded, and C was extremely cloudy. After fourteen days, there was no cloudiness in either A or B, but C was so cloudy and emitted such a stench that it was discarded. The first nitrate test was made after three weeks and a qualitative indicator (diphenylamine-sulfuric acid) was used. A indicated no nitrate but B turned the indicator a strong, blue color, indicating a high nitrate content. After three months had passed, a quantitative laboratory analysis was made (naphthylamine test) with results as follows:

Experiment A: Nitrate content negative, pH 7.70.
Experiment B: Nitrate content 7.5 ppm, pH 7.75.

Next, experiments were made on marine water about two months old having a nitrate content of 3.6 ppm. After ten days of filtration with the special resin, the nitrate content had dropped to 1.4 ppm. The filtration rate was about three and a half gallons an hour. After 18 days of such filtration, nitrate could not be detected. Additional experiments to learn more about the process indicated that the ideal filtration rate was about two to two and a half times the capacity of the tank per hour. It was also found that the intermediate nitrogen products (amino acids and amines) were absorbed more quickly than the end product (nitrate) itself.

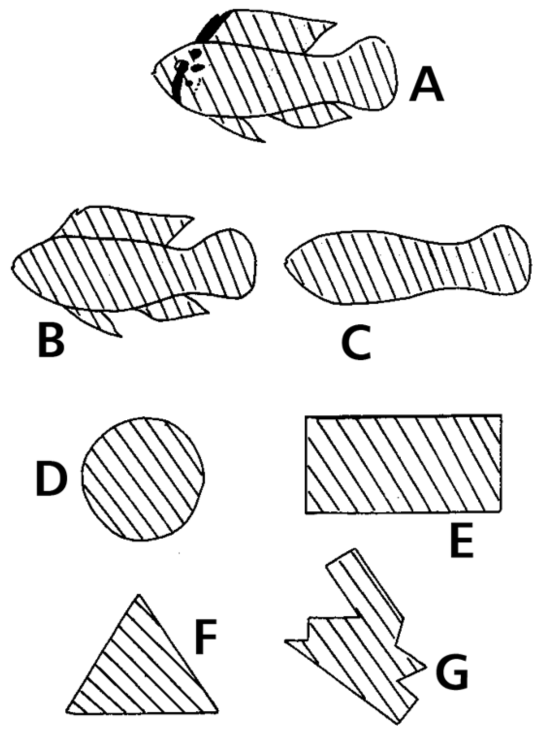
Another series of experiments was conducted on a fully setup marine tank of seventeen and a half gallon capacity containing *Amphiprion percula* (the marine clown fish) and sundry anemones. The filtration rate was seven and a half to eight and three quarter gallons/hour and the initial nitrate content was 1.9 ppm, the initial pH being 7.7. The filter was operated for two full days; then afterwards, two hours per day (enough to send all of the aquarium water over the resin once). Weekly, the pH and nitrate content was checked. After eight days, the pH rose to 8.25, and the nitrate was down to 1.2 ppm. After three months, the pH was 7.9 and the nitrate only 0.2 ppm.

The new resin is *not* designed to filter out debris … it would be a waste to use it for this purpose. Regular filter fibers should be used on top of the resin, before the water contacts it so that only clean water (containing the nitrates) contacts the resin. It is helpful when setting up such a filter to ensure that no air spaces are trapped in the resin since air lowers the efficiency of the material for removing nitrates and other nitrogenous materials. For those marine aquarists wishing to experiment with this new product, it is called N-EX, and it is available from:

W. Seitz
3000 Hannover
Marienstrasse 54
Germany

(Prices are roughly $2.20 for a package sufficient for a 12-gallon tank, and $4.00 for a 25-gallon tank). Specific directions for the use of this product can be supplied from this firm, also. According to literature put out by this firm, a similar material for use in freshwater tanks for breeding and keeping problem fishes is now in preparation.

In past issues of the JOURNAL, I have discussed several of Peters’ famous experiments with “artificial parents” for mouthbreeder young. Recently, Peter Kuenzer has similarly experimented with the young of the dwarf cichlid, *Apistogramma reitzigi,* in an effort to learn more about how cichlid fry recognize their parents. With A. *reitzigi,* it is the female



Artificial parent used in *Apistogramma reitzigi* experiments (after Keunzer).

who rears the young and adult females during this period are colored a bright yellow and carry a number of black markings about head and fins. Mr. Kuenzer made up a number of artificial mothers by cutting them from drawing board, painting them with poster paint, coating the finished product with paraffin, and attaching them to wires. When the artificial mother was moved about in the aquarium, the fry swam to it with varying degrees of alacrity. The faster the fry sped to the model, the better it was adjudged as a substitute. Great care had to be taken with the path and velocity of motion since these were variables, which also affected the responses of the fry. At first, seven artificial mothers were constructed (see sketch), all painted yellow, but of different shapes. Model “a” was very close in appearance to the real parent, and the fry responded very well to it. When model “b,” lacking the black markings was tried, however, the fry responded equally well. As a matter of fact, all of the models evoked the same, excellent response! Clearly, the shape of the artificial parent had nothing to do with the fry's' recognition of their parent. Circles, rectangles, triangles, and even zigzag forms worked equally well, provided they were painted yellow.

Next, other colors were tried. The fry fled from red or black models. Only ochre, orange, and yellow-green showed any allure and even this was slight. Different shades of gray rectangles were tried but were ignored, demonstrating that it was the quality of the color (wavelength) and not its brightness that attracted the fry. The answer to the question of whether this color relationship is inherited or is learned was answered when experiments demonstrated that the same responses were observed whether the fry had been reared in the presence of a real mother, out ever seeing an adult fish.

Organizational Problems, Conditioned Water

[Aquarium Journal, May 1963]

Although my primary interests in his hobby are, like most other aquarists, the fish themselves and related technical matters, one seldom can avoid (nor would one necessarily want to avoid) contacts with organizations which have as their primary function, the furtherance of the aquarium hobby in all or in part. Then too, no man is an island and the instinct to aggregate in a recognizable avocation is strong within all of us. For my own part, this has manifested itself as past and present association with numerous aquarium organizations.

In many of these organizations, we all have seen success and failure, and in the long run, far too often the latter. It is of interest to observe that the identical answer is invariably given to the question of why the group under consideration failed. Roughly speaking, the answer offered is that either the membership refused to support the organization or that it was relatively disinterested. The blame for failure is seldom placed upon the administrators themselves.

Now I take a rather unorthodox position in this matter, believing that almost without exception, the failure of an aquarium organization, be it a local club or an international operation, is due solely to its leaders and not to deficiencies on the part of members. First of all, I cannot understand why the persons who run such organizations are hurt, disappointed, or surprised when they do not receive the membership support they expect. Their expectations are simply ill founded. Like in so many other highly developed countries, our citizens tend to be passive. We, for example, indulge in spectator sports rather than participate ourselves, and we spend hours living vicariously in a phantom world of television. Those who expect different behavior in an aquarium organization are wasting their time indeed.

What then are the mistakes that officers, committee chairmen and administrators in general make? The answer, in my mind, is simple. Although we all recognize the consequences of motives of personal gain, self-aggrandizement, and power, the primary error of the administrative group as a whole is in failing to properly evaluate the resources . . . financial, mechanical, and human (especially human!) . . . at their disposal. Anyone who has ever done any track work knows that a runner must pace himself carefully, and that a disastrous policy is one in which the runner starts out with a tremendous burst of speed. Any newly formed aquarium organization has a built-in quality that is at the same time, both an asset and a liability. This two-faced attribute is enthusiasm. It is the fuel that gets the organization going and it is the fuel, which burns up its bearings and sears its pistons. Almost invariably, it produces a spectacular start, which is praised in the short run, and a dismal finish, which is damned in the long run.

Organizations which have to plead for membership support are not dying … they are already dead. They have burned up their quota of human resources and will come to life again only when these resources are renewed, something easier said than done. I well know, of course, that in the short run, administrators of aquarium organizations can do remarkable things. It is a truism that we tend to find more above-average administrative groups than above-average memberships. This is due to a statistical law which states that the smaller the group size, the greater the probability of obtaining extreme average values (good and bad), combined with the fact that memberships tend to select leaders who are average to above-average in ability vis-à-vis itself (thus weeding out the bad). None of this, however, necessarily bears upon the long run and it is by the long run that we judge the success or failure of any organization. One quickly learns that a hobby is no longer a hobby when it becomes just work. When the fun leaves, so does the hobbyist.

Practical solutions to specific problems are a dime a dozen and we might consider a few. If you are an over-worked program chairman lacking sufficient speakers, try alternating feature speakers with panel discussions. Should you be a harassed editor suffering from lack of material, publish less frequently or condense the size of each issue. And if you happen to be saddled with running a fish show sans staff enough to build racks, provide tanks, air, heat, etc., try running a home show where the judges visit each exhibitor's home. These approaches are not necessarily defeatist (they could be, of course, if the membership was really capable of sustaining better things) . . . they can easily be realistic and in the long run, best for the organization.

At times it takes much courage to be realistic and to stick by the implications of sound judgment. It is much too easy for the other fellow to jeer at a pace set lower than his own. The encomium is given to the "ball-of-fire," rather than to the steady furnace giving reliable heat year round.

One word of caution. If your organization has already sapped the strength of its leaders, don't expect the foregoing sample solutions to work. Starting, for example, a quarterly club publication with a fresh editor and staff is one thing, starting worn out from a one-a-month schedule is another. As with most things, we have to pay something for past mistakes. If "A" drops a safe on "B's" head and then says, "Oops, I'm sorry!" the recognition of the error and the promise to do better in the future doesn't help "B" very much. It also doesn't help "A" immediately since he must wait until another "B" comes along.

Again, I repeat my thesis: it is not the membership that should be blamed for the failure of an aquarium organization but rather its leaders. It is the pacemaker who either wins or loses the

"Looks like Under The Cover Glass has rubbed Sam the wrong way again!"

race for his team and, as Shakespeare once said, “Ambition is made of sterner stuff.”

To return to the “fish” side now, it may seem puzzling at first to assert that there is water and then there is water. If one were to classify water from an aquarist’s viewpoint, we would be forced to recognize four types, viz.,

(1) new water
(2) aged water
(3) conditioned water
(4) contaminated water

It is important for the hobbyist to learn something about the differences among these four types and one of the first requirements is to define our use of these terms. So many times have these terms been bandied about carelessly, that it is a wonder that they hold any meaning whatsoever anymore.

Definition #1: New water is water that has not previously supported fish life and which is essentially free of living organisms.
Definition #2: Aged water is water which has not previously been used by fishes but which has been allowed to stand long enough to develop a significant population of microscopic plants and animals.
Definition #3: Conditioned water is water, which has previously supported fish life.
Definition #4: Contaminated water is water containing any substance present in a concentration such that it is adverse to fishes.

The sources of new water are varied and among these sources we commonly include tap water, rainwater and well water. There are decided differences between new water and aged water. In the latter, some subtle and some not-so subtle alterations have taken place both chemically and biologically. Aging promotes the loss of toxic gases such as chlorine, and encourages the precipitation of harmful or undesirable minerals. This is partially a result of purely mechanical processes, and partially the consequence of the development of a microscopic fauna and flora. The aquarist ages water then, to remove harmful materials and to stabilize its nature so that fishes subsequently will not have to undergo changes in water quality, which may place a strain upon them.

How long does it take to age water? Since temperature and light affect the course of these alterations, it is not possible to provide precise answers. In general, we require a minimum of several days to pass before water can be considered to be sufficiently aged. Since the activity of microscopic organisms is enhanced by the presence of organic materials, the aging process can actually continue for weeks.

Fishes definitely alter the water in which they live and in the process, produce what we call “conditioned water.” They influence its gaseous balance and they convert food materials into gases, liquids, and solids. The extent of these alterations depends upon the species involved, and the relative crowding of the fishes. Conditioned water is favorable to fish life, for reasons that are not quite clear at the present. Perhaps previous fish inhabitants have absorbed toxic substances, altered the ionic array of the water to better support fish life, or produced a bacteriophage that controls the growth of undesirable bacteria. Since conditioned water is favorable to fish life, it is good practice to add conditioned water to aged water before adding fish to the latter.

Contaminated water falls into two subclasses: water contaminated by some outside source such as copper plumbing, and water contaminated by the fishes themselves. The first subclass is obvious enough and much has been written about such pollutants. Some aquarists, however, do not recognize the dangers from the second. After a tank has been in use for a while, the accumulation of nitrogeneous salts as a consequence of fish metabolism begin to affect the growth and health of its inhabitants. In addition, it has been shown that some fishes release both growth and reproduction-inhibiting substances into the water, according to the population density maintained in the tank. Many of these contaminants cannot be removed by filtration or aeration, and must be removed by siphoning a portion of the water out of the aquarium, replacing it with either new or (preferably) aged water.

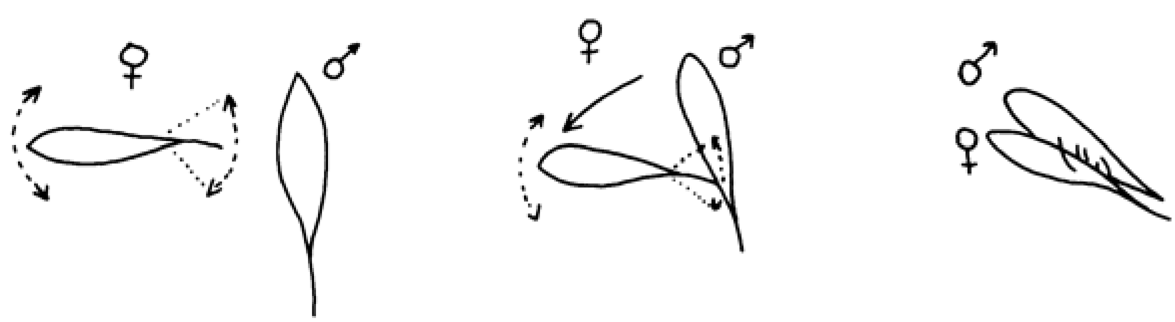
American Flagfish, Mouthbrooders

[Aquarium Journal, July 1963]

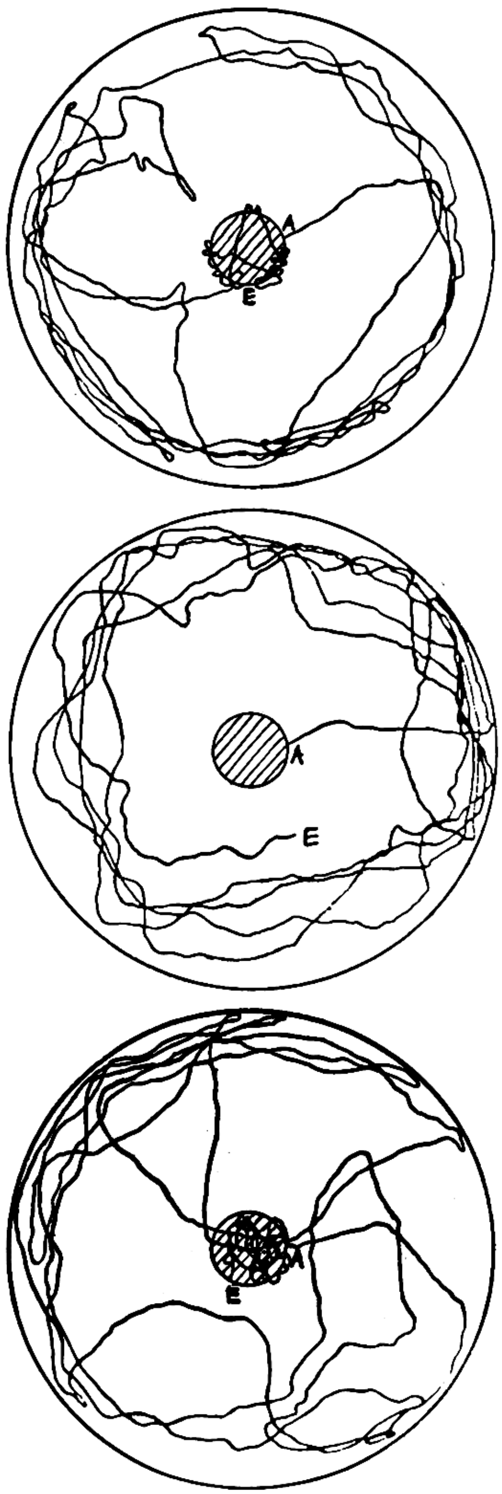
One of my favorite aquarium writers is Helmut Stallknecht of Cottbus, Germany. From my correspondence with him and from reading his articles, which appear fairly regularly in the German aquarium literature, I never fail to admire his observational technique. Consider, for example, a fish, which should be more familiar to American aquarists than to Germans, viz., the American flagfish, *Jordanella floridae.* There is probably more misinformation about this fish floating about than any other species, perhaps because many "authorities" who have described the fish possessed little or no actual breeding experiences with the fish whatsoever. Often, the prenuptials are said to commence with the digging of a sand pit, much in the manner of certain cichlids, with the subsequent guarding of the eggs by the male.

The truth of the matter is that *Jordanella floridae is* more likely to scatter its eggs over sand, plants, mops or what have you with little consideration given to the placement of the eggs. More times than not, any "digging of pits" is accidentally caused by the search (by the male) for eggs, which are greedily eaten, as are the fry. Some males do stand watch over the eggs but this is more like the guarding posture of a stickleback than the guarding plus fanning posture of the typical cichlid.

Getting back to business, however, Mr. Stallknecht has diagrammed the pairing process very nicely in the accompanying sketch. The first phase occurs when the female, ready to spawn, approaches the male tail first. With a motion, which moves her tail to and fro on one end (and her head likewise on the other), her tail moves against the anal area of the male. The second phase occurs when the male envelops the female with his dorsal and anal fins, an action observed in many *Nothobranchius* and *Cynolebias* species, forming a spawning chamber. This activity takes place near the bottom



THE PAIRING OF THE AMERICAN FLAGFISH.
From Left to Right: The female approaches the male, tail first, moving it to and fro. She then moves closer and touches the anal area of the male. The male then envelops the female with his dorsal and anal fins, much in the manner of a *Nothobranchius*.
(After Stallknecht.)



LEFT TOP: Typical path of a fry of the hybrid between *Tilapia mossambica*, a mouthbreeder, and *Tilapia tholloni*, a Pit breeder.
LEFT CENTER: Typical path of a fry of *T. tholloni*. ("A" is the start and E the end in both sketches.)
LEFT BOTTOM: Typical path of a fry of *T. mossambica*. ("A" is the start and "E" is the end.)
Sketches after Peters and Brestkowsky.)

of the tank, and the eggs are released without much regard for the substrate be it sand, peat, plant or nylon.

As with many killies, the flagfish males are very hard on the females and adequate cover must be supplied for the latter to hide in. The hatching time is somewhat dependent upon temperatures but in general, is a week or less.

Although high temperatures may sometimes result in a number of belly sliders, the rearing of the fry is not at all difficult if it is remembered that compared with many killifishes, they are relatively small at birth.

Due to the efforts of Peters and Brestowsky, among others, methods have been developed to enable experimenters to successfully cross certain species of the cichlid, *Tilapia.* Now it is interesting to observe that certain fishes in the genus are mouthbreeders while others are pit breeders. The fry of the former are strongly attracted to the rearing parent by genetic forces. As a result, the fry automatically swim to the parent and indeed, even enter into its mouth should the occasion warrant. The fry of the pit-breeders exhibit no such behavior.

The question is, if a mouthbreeder is crossed with a pit breeder what are the behavioral characteristics of the fry? Do the fry swim to the rearing parent or not? In this case, of course, there is no rearing parent since the hybridization is artificial. Peters and Brestowsky, however, devised an experiment wherein a fry was admitted into the inside of a small globe (one and a half inch diameter) via a tube attached to the globe. An orifice was provided in the globe so that the fry could escape into a shallow, round (10 inch diameter) vessel in which the globe was suspended. The globe was mechanically moved back and forth with an amplitude of about three-eighths of an inch and a frequency of 30 sweeps per minute. Mouthbreeder fry are strongly attracted to such devices as they effectively serve as "mechanical parents." Furthermore, by releasing the fry into such a device at birth, conditions are identical to what it would experience being hatched inside the oral cavity of its mouthbreeder parent. Preconditioning is also eliminated for the fry has no other experiences to bias the experiment.

The hybrid chosen was *Tilapia mossambica* (a mouthbreeder) *x Tilapia tholloni* (a pit breeder), the former being the male.

Typical paths of the fry of the unhybridized species are shown in the accompanying sketches. Forty-three fry in all were involved and a total of 254 trials were made. As expected, the pit-breeder fry does not come to circle the artificial parent, while the mouthbreeder fry does. Clearly, the hybrid follows the path of the pure mouthbreeder fry, indicating that in this case at least, the genetic influences of the mouthbreeder prevailed. The results of other crosses are being awaited to see if this phenomenon is dependent upon either sex of the members of the cross, or the species involved.

Letter from Franz Werner, Book Reviews, New *Rasbora*

[Aquarium Journal, August 1963]

From time to time, I receive letters from readers raising the very roof with me for something I said in print that didn't quite jibe either with their own opinions or their own experiences. These are probably the most interesting letters of all for they not only correct errors on my part, but they frequently start the proverbial wheels turning to give a selected topic some extra thought and study.

One of the author's very good friends is the redoubtable Franz Werner of Detroit, most assuredly one of the most accomplished aquarists in the world, Dean of American killifish fanciers, and fish photographer par excellence. Now in my column for May 1963, I discussed the four types of aquarium water, generally following Lewis' (*Maintaining Fishes for Experimental and Instructional Purposes*) classification but modified somewhat since I did not agree entirely with that author. In any event, water type no. 3 was "conditioned water" and in my column, the following statement was made: "Since conditioned water is favorable to fish life, it is a good practice to add conditioned water to aged water before adding fish to the latter." Now Franz takes vigorous exception to this thesis and furthermore, he appears to have caught me in some flimflammery since I have to admit that as a matter of course, I ordinarily do not add conditioned water to aged water before introducing fish. The following is a short quote from his letter:

"Even in the old days there were some Geheimniskraemers[1] who, having had some success with problem fishes not because of what they did with the fish but rather instead of what they did to the fish, said the same thing: "Ich nahm das Altwasser von einem derzeit fischlosen Aquarium in welchem ich vor geraumer Zeit eine Anzahl von Art X gezogen hate.[2] And from Austria over Saxony to Bremen and Hamburg, you could hear the boys roaring with laughter. In the Rossmaessler[3] in Bremen, der Alter himself laughed so much that he got the hiccups for two weeks and had to forego his daily Schuper of beer!"

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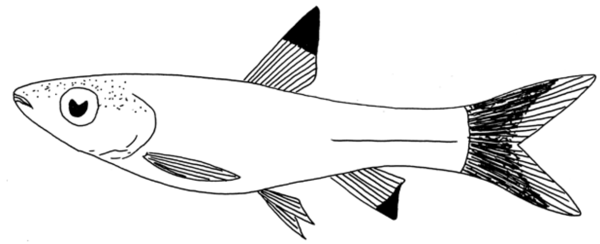
[1] i.e., persons who make a big secret out of the smallest things … we see many of them in our hobby.
[2] " I took the old water from a tank which had been devoid of fish for a while and in which previously I had kept for a long time, a number of species X".
[3] famous German aquarium Society.

After reading Franz' criticism I was roaring with laughter myself! But to return to the point at hand, it certainly is true that the advisability of adding conditioned water to aged water is a moot point. In a very few, select instances, it has been demonstrated that conditioning (as we will designate the practice) is effective (see Breder's article in COPEIA, No. 2, pg. 66, 1931, "On Organic Equilibria"). In a recent series of articles in his popular column, ("Portrait of the Guppy") Mr. Lawrence Konig makes a strong case for conditioning with the well-known livebearer. My own experience is that for the vast majority of egg-laying fishes that I have handled, conditioning is not necessary and, in fact, contributes nothing whatsoever. Since it costs nothing to condition, however, it would seem provident to follow the practice with fishes with which experience is lacking, in the hope that it might just possibly do some good.

It will be good news to aquarists to learn that Prof. Gunther Sterba's great book, *Süsswasserfische aus aller Welt*, now has been translated into English as Freshwater Fishes of the World. This work was ably translated by Dr. Denys Tucker, lately of the British Museum of Natural History, and published by Vista Books, Longacre Press, London. I obtained my copy merely by placing my order with my local bookseller, and I suggest that aquarists desiring a copy of this fine book do likewise. Since I have already reviewed the original German edition (AQUARIUM JOURNAL, March 1960) I will do no more here than say that it is one of the three books I recommend for every hobbyist's library. The other two are Prof. Emmen's, Keeping and Breeding Aquarium Fishes and Duijn's Diseases of Fishes. Like all books, there is a good deal of nonsense in Prof. Sterba's book. (Example - under the heading of the bowfin or *Amia calva* we find: **"In general it should be kept in cool fresh water with a constant slight through-current."**) My experiences with bowfins, one of which is currently a family pet, indicates



Rasbora wijnbergi **Meinken, sketch by Albert J. Klee.**

that these instructions are entirely unnecessary and portions are decidedly dated (killifish fanciers should be wary of the section devoted to these fishes). Nevertheless, it is efficiently written and far superior to anything else in print, no matter what the language being considered. Unfortunately, a good deal of the "nonsense" I mentioned is to be found in the translator's foreword. His statement that **"Germany still leads the world in know-how' and pioneering effort"** is true only in certain selected areas (American equipment is, in general, far better than European equipment; Dutch aquascaping has no peers; the leading killifish hobbyist of the world is a Dane; British and American guppies are among the world's finest, etc.). It is important to give everyone their just due and not to run away with generalizations that overlook the impressive contributions of aquarists all over the world.

While on the subject of new books, hobbyists may be interested in the text by Lagler, Bardach, and Miller entitled, *Ichthyology* (John Wiley & Sons, 1962). As a technical reference on an elementary level, it would provide a nice addition to the three books mentioned above. Chapters of especial interest to aquarists include: Ecology and Zoogeography, Genetics and Evolution, Reproduction, and Foods, Digestion, Nutrition and Growth. One very fine feature is the list of references at the end of each chapter. I was disappointed in only a few portions of the book (Example: The explanation of "multiple allelism" was quite unclear which was unfortunate since it is an important topic in the line breeding of aquarium fishes) and in general, errors are not flagrant (Exception: The statement that *Barbus* contains a live-bearing species, when the fact is that Weber mistakenly took a host of cichlid fry to be the young of *Barbus viviparous*). One of the authors, Dr. Robert Miller of the University of Michigan, has very kindly aided aquarists over the years with certain technical problems and last year, was elected an Honorary Member of the American Killifish Association.

In the "What's New Department" this month, we introduce *Rasbora wijnbergi* (pronounced, **VAIN'**- B E R G-EYE), a native of some still unknown area in Borneo. It is related to *Rasbora dorsimacultata* and fortunately, has been bred by Dr. Meyberg. This fish is silvery with fine, dark edgings on its scales. The back is yellow-olive, the belly whitish. The base of the tailfin is blood red, changing to ochre-yellow out to the tips of the lobes. This latter color is also present on the bases of the anal and dorsal fins, but both are tipped in a deep black. This fish was recently described by Herman Meinken in DATZ, and we hope to see it soon on our own shores.

Astronotus, Paraffin Wax in Decoration, Visit to a Fish Club

[Aquarium Journal, September 1963]

James Thiele, writing in AQUA-FOCUS, tells of some new additions to the list of native fishes of Florida. Several years ago, an aquarium dealer decided to discontinue handling the cichlid, *Astronotus ocellatus,* and not wanting to destroy them, released them instead into a canal located about 15 miles south of Miami. The number of fish involved amounted to about 100 large specimens. Nothing more was seen or heard of the fish for about two years and due to the fact the local waters vary in temperature from 30° F. in the winter to about 95° F. in the summer, and also because the canal in question is affected by tides and the influx therefore of salt water, the fish were presumed lost forever.

However, it now appears that they are firmly established and that local fishermen consider *Astronotus a* game and food fish par excellence. Some of the common names bestowed by the fishermen include, "black bass," ringtail perch, rock bass, and sweetwater jewfish. Not an "oscar" in the bunch! Evidently, they are game fighters on hook and line. More interesting is the fact that they are tasty eating!

That this tropical fish has managed to establish itself despite the adverse elements mentioned plus competing fishes, is evidence of a rugged constitution. However, aquarists were never in doubt about that at any time. Another fish occasionally found in Florida waters is the Asian snakehead, *Channa asiatica.* It is not known who was responsible for this introduction.

Bulletin browsing was especially profitable this month and an article by Harold Morrison in the Chicago Aquarist entitled, "Paraffin wax as an aid to decorating an aquarium," particularly was of value. Mr. Morrison attains unusual effects in the aquarium by molding gravel, sand, rocks, etc., into different shapes with melted paraffin. When the paraffin cools, the design is "frozen" and may be used right in the tank with the fish, since all materials are non-toxic.

Ordinary paraffin wax from the grocery store is used. The paraffin should be melted, of course, but it is also recommended that the gravel and other material be warmed first in an oven, also. The wax can be ladled out with a spoon as desired. A pan, a piece of glass or even a piece of cardboard can be used to support everything during construction, the only requirement being that it be dry and warm.

Many interesting effects can be created by applying gravel and wax to the inside back wall of the aquarium. Small vials may be incorporated to hold plants. Special chambers including circulation holes can be molded into a wall to accommodate heaters, thermostats, filters, etc. Multilevel terraces can also be created, using stones plus a wax and gravel "mortar." A little care must be taken that these hot mixtures do not crack the aquarium glass to which they are applied, but a little practice on an old piece of glass will solve this problem. All in all, the wax technique should provide aquarists with another dimension in aquascaping.

Recently I attended a meeting of an out-of-town aquarium society, the results of which may provide some food for thought for other such organizations throughout the country. Because my name is not pronounced the way it is spelled, I was able to attend incognito" and to settle down in the rear row, relax and observe the proceedings come as they might.

The meeting was scheduled for 8 p.m. but it actually started at 8:20 p.m. The first order of business was the reading of the minutes of the previous meeting. After 20 minutes had elapsed, it was obvious that a man with a No-Doz concession would have made a fortune and indeed, I myself remained in a sitting position solely because the shirt I was wearing was heavily starched. At frequent intervals, corrections, additions, deletions and other carefully assorted trivia were offered. A typical correction involved changing a sentence like, "Grape juice was served..." to "Orange juice was served . . ." Consequently, I reminded myself to forego the liquid refreshment that evening. Any drink, the flavor of which is difficult to distinguish between orange and grape, is definitely to be avoided.

Fortunately, the Secretary retired some 7 pages of corrections later and "old business" was finally introduced. It turned out that this was mainly concerned with a previous show. The audience emerged from its chrysalis and free-for-all, round robin mayhem commenced. Apparently, some dozen or so entries were overlooked during judging. Since the judges wisely lived about 100 miles away, an informal contest was held to find an unfortunate at whose feet the blame could be laid. Using a logical process with which I am not familiar, this turned out to be the Sgt.-at-Arms. Another crisis occurred when it was discovered that the Show Chairman had been soundly berated by the exhibition hall's owner for eating a chicken (or was it liverwurst?) sandwich on the premises. This was adjudged an affront to the society and a committee was appointed to investigate.

Relief was promised when "new business" was announced. When a member rose to announce that he had two amendments to the constitution to propose, I edged closer to the door. It would be too painful for me to describe the subsequent discussion and cross-discussion. Massive doses of tranquilizer still have not settled my jangled nerves. One of the amendments involved rules for election of officers although from what I was able to observe, this could just as well have been decided by drawing straws, the loser being required to assume office.

Break time arrived and along with it, the fish-of-the-month bowl show. However, judges had not yet been selected so a draft was made. One lady tagged for this purpose protested, all the way to the judging table, that she knew nothing whatsoever about judging fish. This proved to be an understatement for the awards appeared to have been made on the basis of a table of random numbers and a roulette wheel.

The raffle time commenced. Twenty or so small items were available and each one was raffled off separately, an agonizing slow process. There was a moment of panic when I saw that the next item was a bag of charcoal and wondered if it would be raffled off on a per grain basis. The bag broke, however, thereby avoiding confrontation of the problem. The program finally started at 10:15 p.m., about two and a half hours after the official start of the meeting. On the long drive to the meeting I had fretted about being late but I could have easily stopped off and had a valve job done on the car without missing a thing. Both the car and myself would have been the better for it, too.

My last thin thread of patience almost snapped when I found that the program consisted of slides of the show mentioned previously. The pictures appeared to have been taken by someone afflicted with Parkinson's disease. No attempt was made to discuss the fish shown but I did get a glimpse of the chicken sandwich that caused all the discussion during the business meeting. Unlike the fish, however, the chicken turned out sharp and clear on the slides.

Shortly after 11:15 p.m., it was announced that there were three reels of movies of the show to be run next. At this point hysteria took over and I broke and ran, not relaxing until after I drove well beyond the city limits. A number of times in the past I have urged hobbyists to attend meetings of their local aquarium societies. If the foregoing account bears any resemblance to your own experiences, you have my profound apologies indeed.

Jean Louis Rodolphe Agassiz

[Aquarium Journal, October 1963]

Often I have been asked what I do when I become bored or "fed up" with the hobby. The answer is, "It never happens!" There are too many facets to this hobby of ours, and far too much breadth to let this occur perforce. When the "Lemma of Maximum Perversity" (Beginner's Corner, pgs. 339-340, July 1961) strikes once too often, forget about the fish for the moment and strike out in a different direction. Just to show that I sometimes take my own advice, the following is the result of a brief sabbatical I took when fingers became waterlogged, eggs fungused, and glass cracked.

The name Agassiz is not unknown to aquarists whether it be found after a fish name such as the mosquito fish (*Heterandria formosa* Agassiz) and the oscar (*Astronotus ocellatus* Agassiz), or as a part of a fish name such as the dwarf cichlid, *Apistogramma agassizi*, and the catfish, *Corydoras agassizi*. These are just a few examples for many more could be cited. As aquarists know, the first two examples typify the manner in which the name of the person who first described and named the fish is appended to its name, while the last two examples show how a person is honored by having a fish named after him. This would be reason enough to review the life of this man but Louis Agassiz was more than an ichthyologist, and a brief biographical sketch would serve as a change of pace to the ordinary run of aquarium topics.

Jean Louis Rodolphe Agassiz (called "Louis" by his family and later on, "Agass" by his friends) was born in Switzerland in 1807. At an early age he determined to become a leader in the sciences, and a leader he became. Agassiz's family belonged to the professional class of teachers, clergy, and physicians but at first, they wished young Louis to prepare for a business occupation. A business career to a young man, who as a child converted a stone catch basin behind his home into an aquarium, learned the Latin names of every animal he found and established a museum of natural history in miniature, was not palatable. A compromise was reached whereby Agassiz would study medicine . . . the University of Zurich was his first stop, Heidelberg his second. At Heidelberg he developed an interest in paleontology and geology but he never outgrew the science, which from the start, held a special fascination for him, i.e., ichthyology. At this time, he was attracted by the University of Munich and after many appeals, convinced his parents to let him go.

At Munich, Agassiz's nickname among his comrades-in-science was "Cyprinus," a portent of things to come. Of all the eminent naturalists at Munich, none was a specialist in ichthyology so Agassiz determined to fill the void. He started working on an account of European ichthyology and this attracted the attention of one of his professors, Von Martius. In 1817-1820, the expedition of Von Martius and Spix to Brazil had taken place but the task of describing the fishes collected from the Amazon River system in Brazil remained unfinished because Spix died in 1826. Von Martius, who was a botanist, asked Agassiz to take on the job and he gleefully agreed. In May of 1829, his *Brazilian Fishes* appeared in print. It was a moderately distinguished work by a 21-year-old naturalist but it gave him a reputation in Europe.

This success gave Agassiz the courage to write to Baron George Cuvier, one of the greatest naturalists of that age. Cuvier's name is, of course, well known to aquarists familiar with the Latin names of fishes. The Baron was quite impressed with Agassiz but more about that later. One result of Agassiz's book on Brazilian fishes was that it earned him a Ph.D. in natural history. This was not quite the goal he promised his parents although they were very proud of him and his accomplishments. However, he agreed to obtain his degree in medicine, a promise he kept with little trouble, thus winding up with two doctorates. He was, however, never to practice medicine. His love of natural history always came first.

Agassiz became a frequent visitor to the home of Cuvier. Another friend was the renowned scientist, Alexander von Humboldt. With Cuvier's encouragement and with Humboldt's talent for securing funds, Agassiz's greatest work was published over a period of a decade . . . the five volumes of *Poissons fossiles* (Fossil Fishes). This fantastic work described over 1700 species of ancient fishes. It qualified him as a master of his time, and as the logical successor to Cuvier who had died a year before the first volume was published.

The study of fossil fishes quite naturally led him into geology and subsequently into a study of glaciers. His ideas on glaciers and the Ice Age really established Agassiz as a pioneering intellect. Unfortunately, his geological studies convinced him of the rigidity of species, thus involving him in some controversy. His concept of species was that they remained unchanged from the time of creation, that species disappeared as a consequence of catastrophe only. It is also a regrettable observation that Agassiz's marriage was not really much of a success. These were the burdens of a man devoted to science.

Agassiz's growing fame brought him to the attention of a group of American men of sciences. With the encouragement and assistance of his friend Humboldt, he set out on an American lecture tour in 1846, hoping also to study glaciation there. Agassiz was immediately taken with America and America with him. His lectures were received enthusiastically and a year later, Harvard offered him a professorship. Agassiz accepted the post of Professor of Geology and Zoology, and this launched his American career. His very first real expedition of his life took place in the area about Lakes Erie and Superior, resulting in the book, *Lake Superior*. He compared fishes of Europe and America, discovering striking differences. The one cloud at this time was the death of his wife who had stayed behind in Europe.

Perhaps Agassiz's greatest American achievement was his founding of the Museum of

Comparative Zoology at Harvard. His reputation as a teacher was phenomenal and his students hung onto every word. As the leading man of American science, it was understandable that Agassiz should become embroiled in certain controversies, however. A major controversy arose over Darwin's *Origin of Species*, a view that Agassiz vigorously opposed. He also maintained that negros and whites were of distinct origins and probably even distinct species. His refusal to admit evolution plausible was a defect on his character since it was based upon a refusal to examine the scientific basis of his own views. In this fight, Agassiz was the leader of an older generation, doomed to defeat by succeeding generations. In later years, however, his views towards Darwin were somewhat moderated.

Agassiz's controversies with other ichthyologists are also of interest to aquarists. One of his most famous feuds was with Spencer F. Baird, the founder of the U.S. National Museum. Agassiz attempted to block his election to the National Academy of Sciences but was unsuccessful. Baird had no love for Agassiz since the latter had the unfortunate European habit of "borrowing" museum specimens and returning them years later if ever. A student of Agassiz who had followed him from Switzerland, Charles Girard, deserted Agassiz to work with Baird. Together or singly, Girard and Baird described many American fishes. When Baird and Girard published anything jointly, Agassiz was sure to give it a rough going over in review. With time, Agassiz's authoritative hold on the Museum he founded alienated others of his students as well. One of these, Frederick Ward Putnam, who had named a blind cavefish in Agassiz's honor (*Chologaster agassizi*), argued with him over Putnam's desire to publish his own research (Agassiz didn't think it was ready for publication) and also over certain financial matters. Putnam broke off his association.

Agassiz died in 1873 at the age of 66. In spite of these blemishes, the career of Agassiz is outstanding. As founder of the Museum of Comparative Zoology and the National Academy of Sciences, as a popularizer of natural history, author of the *Contributions to the Natural History of the United States*, head of the *Thayer Expedition to Brazil*, and one of the founders of Cornell University, his accomplishments cannot be denied. To be a man of many sides was to count as many men. He made life richer by bestowing his wealth upon his own times.

Tank Decorations, Judging, New Species

[Aquarium Journal, November 1963]

It has often been stated that our British friends are somewhat without humor. Nothing, however, could be farther from the truth. Who could fail to be amused by a Peter Sellers movie? In aquarium humor at least, the following item should end the argument once and for all. It was discovered (author unknown) among the files of the Croydon Aquarists' Society and reported in the British magazine, THE AQUARIST & PONDKEEPER (Vol. XXVIII, No. 3, 1963):

Recommended Standards for Tank Furnishings Other Than Fishes and Plants

1. Divers should be large-headed, big-booted and of heroic stance. Any sign of Duck's Disease will be penalized. Inclusion in the same tank as number 5 below to be considered dangerous.

2. Frogs. Bubbles ejected from the mouths of ornamental frogs shall be spherical, I inch in diameter, and released at regular intervals of 80 seconds. Bubbles passing out from the other end will be disqualified. The frog is to be highly colored and of no known species.

3. Sunken galleons must be small enough to look ridiculous when compared with the accompanying fishes, and must not be shown in marine tanks where they might appear more logical. It is recommended that they be placed poop over sprit. The captain must always be visible, as a ship which sinks without its captain will be penalized as unsporting.

4. Glass marbles are to be at least half an inch in diameter, the larger the better as more decaying food and other debris can be accumulated between them. Colors are to be violent and to clash with one another as much as possible.

5. Mermaids will be judged in two parts. The upper half is to resemble as nearly as possible "B.B.", but with hair reaching to the waist. The bosom must be well developed and evenly balanced. The lower half should bulge attractively at the hips, then taper off disappointingly to end in a caudal fin unlike that of any known fish.

6. Treasure chests should have four sides and a lid. The lid may be permanently open, in which case the treasure should be tawdry and glittering. When the lid is closed, but bursts open at nerve-racking intervals to release a gob of air that knocks fishes sideways, no one will care whether there is treasure or not. Preference will be given to chests so overgrown with algae as to be unrecognizable.

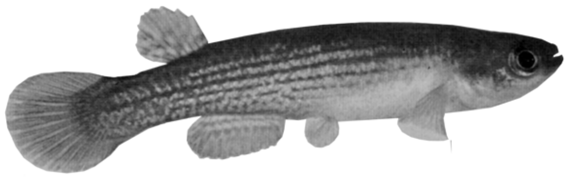
7. Submerged castles must give no indication as to why they are submerged. The highest turret must be below water level; aerial turrets will be penalized. There should be enough room inside for dead fish to lie unnoticed. The architectural style recommended is Butlin's Fun Fair, early period.

Scale of Points

Whimsicality ------------------------	20
Gaudiness ----------------------------	20
Futility --------------------------------	20
Disproportion ------------------------	**20**
Tastelessness ------------------------	**20**
	100

Although the following account will probably become a classic in the hobby, it is offered to support an important point, viz., that the scope of the hobby is so broad that it is an anachronism to have one person judge an all-species fish show. Some time ago, a Cincinnati aquarist who entertains a rather dubious reputation as an "expert" (mostly in guppies) was invited to judge an all-species show in a nearby city. Entered in the show was a superb pair of blue gularis *(Aphyosemion coeruleum* ... very large, colorful, and stately. The fish frankly stole the show and spectators not familiar with killifishes pressed to learn what kind of a fish it was. Such interest forced even this poor excuse for a judge to rate the fish highly. However, the fish did not win best in show (or even best in its class), a surprise to all concerned.

The judge rated the fish tops in deportment (the fish had its fins spread constantly), size, and color, but marked its truly magnificent finnage (the finest to be seen in many years) down because "its anal fin was ragged"! One may well expect an aquarist not familiar with killies not to know that the anal fin of a blue gularis is by nature "ragged," but there is no excuse for such incompetence on the part of a judge who has accepted such an assignment as an "expert." To even accept such an assignment in the first place is unethical by any judging standards. As a result, the exhibitor lost out on two trophies and spectators went away lamenting that such a beautiful fish "lost out because of defective finnage." There are so many fishes that it seems only common sense that one man cannot be expected to be knowledgeable in all of them. Show committees would



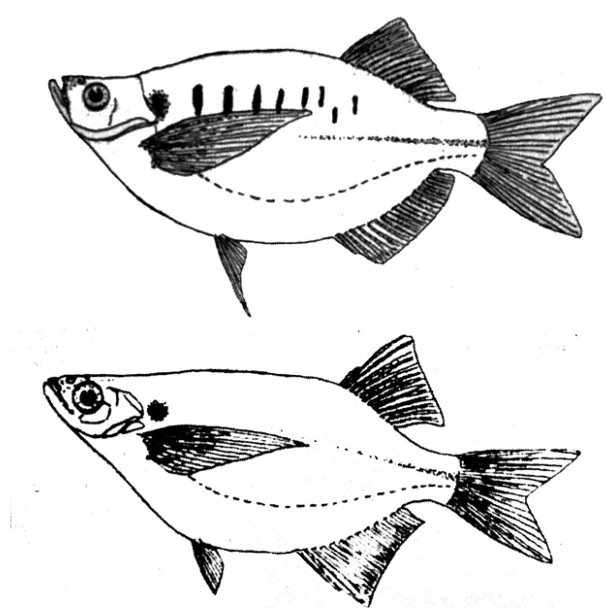
***Rivulus limoncochae*, male, as photographed by the author.**

do well in ensuring that provision is made for multiple judging in all-species shows, and that a "guppy judge," a "killie judge" or a "betta judge" is not necessarily competent to judge fishes other than within his own specialty.

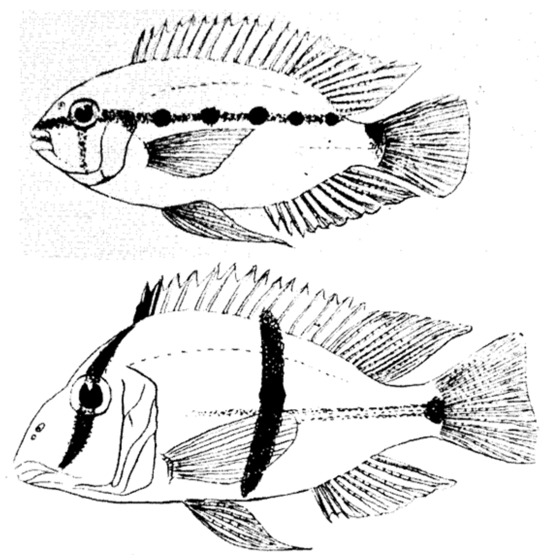
A number of new aquarium fishes have appeared on the scene lately, "new" either in the sense that at least it has been some time since their last importation, or else are brand-new fishes indeed. In the United States, for example, quantities of Asian fishes are being seen at importers fairly frequently. I was pleased to obtain a specimen of *Osphronemus goramy* at the Fish Bowl in Irvington, New Jersey, this summer, and a rather strange member of the Gastromyzontidae from Paramount Aquarium in Ardsley, New York. The former fish is the original "gorami," lending its name in emended form to a whole series of familiar aquarium fishes. It has become quite a pet in my household and comes to the surface to accept food from the fingers. Although not pretty, its unusual form and interesting motions ensure it a permanent place in my collection. The latter fish is a real "cliff climber" and has astounded me no end by being able to climb the vertical and rather smooth sides of a plastic container, right up out of the water!

Asian fishes seen in Germany lately include *Chela caeruleostigmata* (see figure) and *Chela mouhoti,* fishes that I popularly call "glass barbs." These fishes are quite transparent, resembling glassfish *(Chanda)* in this respect. However, they are not glassfish but are related to the barbs and minnows. They originate from Thailand. An excellent reference to these fishes is in the German aquarium magazine, DATZ, Vol. 16, No. 9, 1963.

In killifishes, many new kinds have been seen. Among these are *Austrofundulus transilis, Pterolebias maculipinnis, Pterolebias zonatus, Aphyosemion spurrelli, Epiplatys sheljuzhkoi spillmanni, Micropanchax cabindae,* and *Rivulus limonocochae.* In addition, there are three or four more species, the identification of which are in doubt. Both *Pterolebias* species are interesting but *zonatus* promises to become a much-sought-after fish. It is basically a *Pterolebias* with vertical stripes. Of the *Micropanchax* species, *cabindae* should prove to be immensely popular. It is a large, bluish version of the hummingbird *Micropanchax (M. myersi),* easy to breed, rise and to keep. We plan to report in considerable detail on this fish shortly. The other species is somewhat less attractive (but very similar) and will be reported upon in the *Journal* by Col. Scheel very soon, also. Past articles in the *Journal* have already mentioned *Aphyosemion spurrelli* and *Austro-*



Upper: *Chela caeruleostigmata*. LOWER: *Chela mouhoti*. Both after Meinken.



UPPER: ***Aequidens itani*****.**
LOWER: ***Geophagus surinamensis*****.**
Both after Meinken.

fundulus transilis (see issues for Vol. XXXIII, No. 10, 1962 and Vol. XXXIV, No. 5, 1963) and readers are referred to these issues for additional information.

The *spillmanni* subspecies of *Epiplatys sheljuzhkoi* differs from the type in that the males carry the vertical bars, as do the females. The American Killifish Association is currently making the distribution of this fish possible to aquarists all over the world. Finally, the *Rivulus* species being imported today are without doubt, going to elevate the genus in the estimation of aquarists everywhere, and impart to it a reputation for containing some of the most beautiful fishes in the hobby. *Rivulus limonocochae* (see photograph), a crisp, green-striped fish is a case in point. Incidentally, other pretty *Rivulus* species have been imported also, but their correct names are yet to be determined (as of this writing).

In Germany two new cichlids have been introduced: *Aequidens itani* from Surinam, and *Geophagus surinamensis,* also from that country (see figure). The latter identification is, however, not definite yet. This short account of new fishes is not, of course, intended as a first description of any of these fishes but merely to answer the perennial aquarist's question of, "What's new?" The answer is "Plenty!" and hobbyists have much to look forward to in experimenting with new and exciting fishes.

Jon Krause,
Tournavista Peru, Fishes

[Aquarium Journal, January 1964]

Those readers familiar with the "most unforgettable character" vignettes that appear regularly in the Reader's Digest, doubtless have likely candidates of their own to endorse for such honor. One of my personal nominees, however, would be Jon Krause of Columbus, Ohio. Jon is owner of Verco Tropicals Fisheries, one of the few importing firms not located either on the West or East coasts, or in Florida. I first met him in 1952, shortly after he had purchased an old greenhouse with a view towards converting it to a fish hatchery. At that time, it was obvious that Jon had years of work ahead of him before he could convert all of his dream into reality.

One of those dreams recently did become reality, however. This summer, Jon flew to Peru in his own airplane (a converted B-25 which he pilots himself) and set up a fish collecting compound in Tournavista, a small town in the heart of the Peruvian Amazon located at an altitude of about 800 feet and not too far from the Andes in Central Peru. For some time previous to this, he regularly flew four missions a year to Leticia in Colombia, and Iquitos in Peru, picking up aquarium fishes collected by professionals. Now, however, he adds one more stop … Tournavista.

Tournavista is, of course, located in a rainforest area. It is a settlement along the Pachitea River, not too far from its junction with the

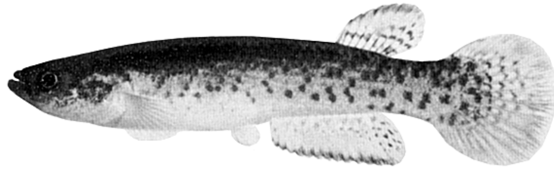


FIGURE 1: ***Rivulus peruanus*****.**
Photos by the author.

Ucayali, the latter an impressive stream traversing the length of Peru. Also nearby is Lake Caymito and a bit farther north, the town of Pucallpa and the Rio Aguaytia. Jon uses a craft known locally as a "peki-peki," a sort of hollowed-out tree canoe equipped with 9 horsepower Briggs & Stratton engines, for his collecting trips and, of course, is assisted by his native staff.

Since Jon is a quiet, modest man, he is somewhat difficult to "pump" for some more exciting adventures. As with all collectors, he must beware of or fight "alligators," piranha, candirus, gnats, and various types of infection. According to Jon, the insects pose the greatest problem. A more serious situation, however, developed on his last trip. During a collecting foray, a sudden tropical deluge occurred and he sought refuge in an abandoned jungle hut, of a type built on stilts. Unfortunately, the rain was so strong that the hut collapsed and Jon was injured, so much so that he could not safely fly his plane out of Tournavista! After some weeks of recuperation, however, all was well again.

The fishing in this area is very fruitful for aquarists. Right behind Jon's compound in Tournavista is a ditch loaded with killies. All that needs to be done is to scoop them out! The fish in question appears to be *Rivulus peruanus* and marks the first time this fish has ever been imported for aquarium purposes (see figure 1). It is a large, beautiful fish, basically a bright blue with dark red markings all over its body. More will be said about this fish in a future article.

Among other fishes that I have seen for the first time at Jon's establishment includes a new characin, one I call the "sicklefin characin" (see figure 2). It is also large, a greenish-blue iridescent beauty with a prominent bronze spot behind its gill plate. This is truly a show fish in every sense of the term and accordingly, I have sent specimens to my friend Rosario LaCorte, the noted specialist for breeding characins (among other selected groups of fishes), with the hope that he will be able to spawn them. **[Editor's note: This fish appears to be *Prionobrama filigera*, a characin often confused with the giant bloodfin *Aphyocharax alburnus*, itself often confused with the bloodfin *Aphyocharax rubripinnis*.]** Another interesting fish is a new *Aequidens* species (see figure 3) a chocolate colored fish characterized by a line that continues from the eye right up into the dorsal fin!

Flying to South America is quite an experience. After talking to Harold Edmonds, one of Jon's key employees and who also assisted with the wiring of the B-25 for instrument landings, I learned that in general, one flies into the wilder parts of northwestern South America only in the mornings. The reason for this is that storms occur in the afternoons and few of the airstrips involved have facilities for instrument landings, which would be, of course, the *only* way to land under such weather conditions. Heading home, the situation is different for the, airports along the way have such facilities and takeoffs can be made almost anytime.

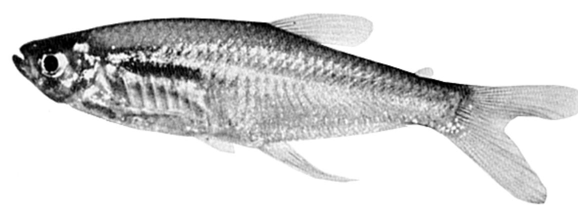


FIGURE 2: The "sticklefin characin."
Apparently *Prionobrama filigera*.

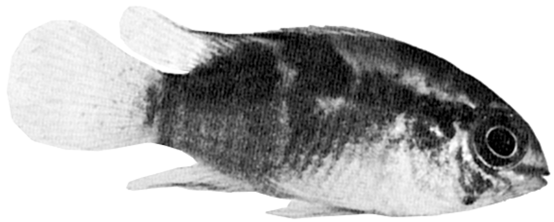


FIGURE 3: A new *Aequidens* species from Columbia-Peru.

During my last visit to Jon's hatchery, I met Carlos Beya, a Peruvian national who was staying with Jon for a few months, to return on the next flight to the compound in Tournavista. He described the natives of the Tournavista region, e.g., the Champas, Campas and the Chapebas, all of which derived their living from hunting. However, the most interesting thing I learned from Senor Beya was that in his hometown, the city of Lima, Peru, the citizens there consider the keeping of live fish in the home to bring bad luck. Aquarium societies in our own country usually have a rough row to hoe but imagine the extra hurdle our Peruvian friends must overcome!

Fishes From Hawaii Via the Mails, Letter from Dalgleish, Veterinarian Laws Affecting Aquarists

[Aquarium Journal, February 1964]

Not infrequently my mailbag contains some rather remarkable surprises. As an example, consider a letter received from Lt. Rodney R. Guidry, USN, of Honolulu, Hawaii. I had not known Lt. Guidry previous to this but his letter stated that he had read of the technique that I had developed for shipping live fishes through the ordinary mails (see my Under the Cover Glass column for June, 1962) and had decided to test it out by shipping me some Hawaiian fishes. Now Hawaii is not exactly just around the corner from Ohio so my immediate reaction was, "Bye, bye little fishes." Well, I should have been of better heart for Lt. Guidry's fish arrived in excellent condition, spending just two days in shipment! There were a total of 7 fishes sent, a mixture of various *Limia* and *Gambusia* species, these being introduced species to that *Stagy* Previous to this I had successfully sent cichlids, characins and killifishes (some spiny eels, also) through the mails but not only was now another category added, but the distance involved was tremendous. The cost, incidentally, was a bit over $2 to mail all 7 fishes. A heavy dose of tranquilizer (Metab-O-Fix) was used but a few hours after release into their new quarters, the effect of the drug had completely worn off. One ancillary result of this experience was that our local postmistress wrote an article for one of the postal magazines, describing these little boxes containing live fishes that stream past her desk each month! While on the subject of shipping live fishes, I have noticed that there has been a tendency to use the new, molded (and beaded) polyfoam containers to an increasing extent lately. These containers generally work well but it is recommended that they still be encased in an outer container made of cardboard for added protection. The polyfoam containers are not very strong by themselves and I have found many of them to split open during shipment.

The following is an excerpt from a letter received from a friend, Mr. Ted Dalgleish, of Nova Scotia, Canada:

"I think my first killie was *Aplocheilus lineatus* and I have had them "off and on" during the past twenty years. I wished to pass along a rather recent anecdote concerning this old acquaintance, if you think it would be of interest to your readers, especially those concerned with the "fragility" of eggs. While preparing two small tanks I placed a couple of three-quarter grown pairs (about 23 inches) in a half-empty aquarium, unheated, in the basement. It contained a few skimpy strands of

Fontinalis. I removed the pairs in about one week and transferred them into their new quarters and, as I needed their temporary home for another purpose, I siphoned it out completely and washed it and the sand with warm water and salt. I then filled the aquarium with soft, acid water, adjusted the thermostat, planted it and left it to settle for a week. Imagine my surprise to find over a dozen tiny lineatus cruising about the surface a few days ago! As eggs, they had survived several temperature changes (and extreme ones), drying, and a brisk scouring through the sand. Undoubtedly a number of them didn't survive but there is an obvious conclusion, i.e., that it would take an extremely violent natural upheaval to completely eradicate this particular species."

Incidentally, Ted has an excellent sense of humor as his following comment on my own *faux pas* in addressing a letter to him once as "Mr. Daglefish," attests:

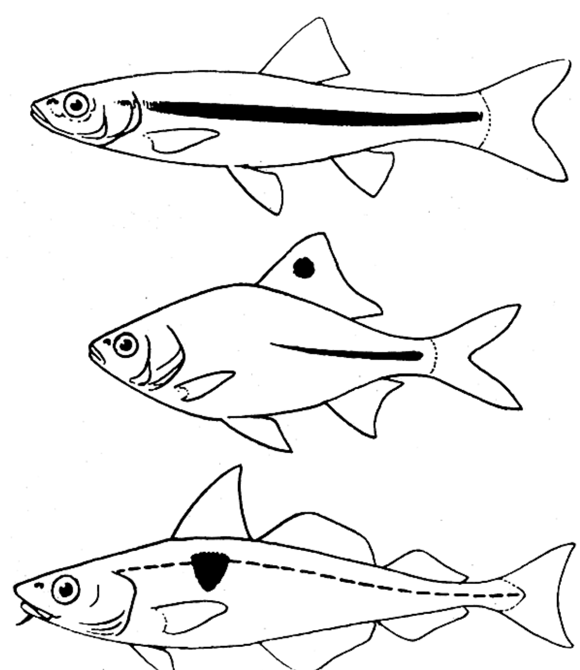
"I should mention that your spelling of my name brought back a rather fond memory of a friend whom I have not seen for years, who has always called me by that name, following an incident when I was paged by loudspeaker in his presence by a hospital clerk who also had difficulty with Dalgleish: He had a good reason to guffaw . . . his name is Danylyshyn!"

The patterns (lateral band, dorsal spot, body spot, etc.) shown on the fishes in Figure 1 are quite common among aquarium fishes. Ever wonder why? In his book, *The Ecology of Fishes* (Academic Press, 1963), G. V. Nikolsky explains that such patterns are particularly distinctive and are frequently used by schooling fishes to orient individuals in *the* school to each other. Want a clue as to whether an aquarium fish in nature is an inhabitant of fast-flowing waters or slow-moving waters? Figure 2 shows cross sections of a number of fishes from both types of waters. In fishes that inhabit waters with slow currents, their body is more flattened, and they are not such good swimmers as the inhabitants of fast streams. All this, of course, is by way of recommending this interesting book to all aquarists. It contains a wealth of information presented in a very readable manner.

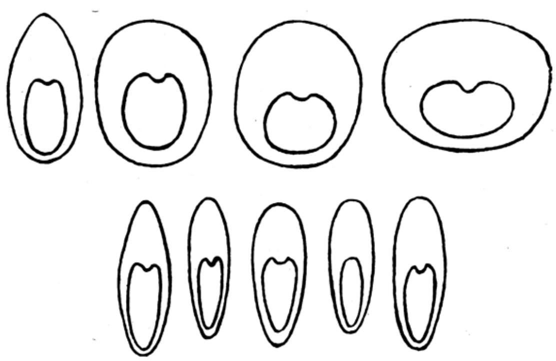
In the November 1963 issue of PET SHOP MANAGEMENT, an article titled "Pet Shops vs. Veterinarians," caught my attention. One section of particular interest was a quote from the new Illinois Veterinary Medicine and Surgery Act:

"Section 3. Any person shall be regarded as practicing medicine and surgery within the meaning of this Act who:
I) Directly or indirectly diagnoses, prognoses, treats, administers to, prescribes for, operates on, manipulates or applies any apparatus or appliance for any disease, pain, deformity, defect, injury, wound or physical or mental condition of any animal or bird, or for the prevention of, or to test for the presence of any disease of any animal or bird..."

It appears that in Illinois at least, any person involved in the above activities is "practicing



Recognition and orientation markings in schooling fishes (after Nikolsky).



TOP (round sections): Fishes from fast waters. BOTTOM (flattened sections): Fishes from slow waters. (After Nikolsky.)

veterinary medicine." Since "animal or bird" (apparently the veterinarians who helped draft this bill had some doubt as to whether a bird is animal, vegetable or mineral!) also includes fishes, aquarists are subject to this law also. Now I understand perfectly well that the Illinois law was designed to regulate primarily other than hobbyists but the fact remains that hobbyists are still subject to it. Furthermore, although any good ichthyologist could run rings around any veterinarian when it comes to fish diseases, the former also is restricted under this law. There are two ways to look at the situation. Firstly, if veterinarians intended to include hobbyists then it is a sorry law indeed.

I have never yet met a veterinarian (other than also a fish hobbyist) that could even pronounce the name of a fish disease, let alone diagnose and treat one. Secondly, if veterinarians didn't intend to include hobbyists, then the situation is even sorrier. A law that says something it doesn't mean is a bad law indeed. Aquarists should watch developments like this carefully. Before we know it, it might well happen that similar laws could force remedies from the shelves of our dealers, or prevent dealers from dispensing advice as to the treatment of a fish disease. Sound ridiculous? Well, it happened to bird fanciers in Illinois already, in fact, it has also happened to bird fanciers in California. Just listen to this quote from a member of the House of Delegates of the American Veterinary Medical Association with regard to birds:

"In the Chicago area we have several veterinarians who are qualified to treat birds and we feel they are the only people who have the training to properly look after the medical and surgery problems of birds."

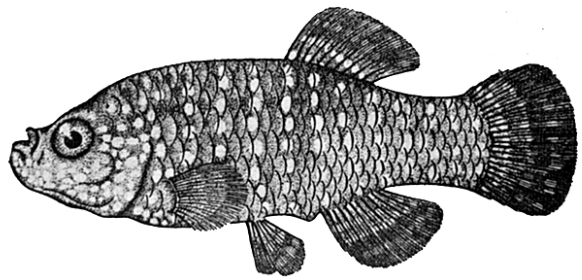
Just imagine, "several" vets to deal with the bird problems of a city of well over 3 million (and goodness knows how many birds)! We wonder how many "qualified" vets there are in the Chicago area who can treat fishes?

Aphanius, Scheel, Nieuwenhuizen, LaCorte

[Aquarium Journal, March 1964]

For over half a century, aquarists have kept and bred at irregular intervals a star-spangled beauty that has been masqueraded under the nom de guerre of *"Aphanius sophiae."* This fish, the male of which at breeding time is deep black with shining silvery spots, needs no introduction for not only have a number of articles about it appeared in the American aquarium literature, but the fish itself is well-distributed among killifish fanciers throughout this country. The only problem is, the name is quite wrong!

Aphanius sophiae was described in 1846 by the German ichthyologist Heckel but right from the start, a bit of confusion surrounded its name for at the same time, Heckel also described *"Lebias punctatus"* and *"Lebias crystallodon" ("Lebias"* was the term used at that time for *Aphanius),* both of which later turned out to be merely synonyms of *sophiae.* Furthermore, three more synonyms were added by Jenkins in 1910, viz., *"Cyprinodon persicus," "Cyprinodon blanfordii"* and *"Cyprinodon pluristriatus" ("Cyprinodon"* replacing *"Lebias"* for a short while). Again, all were synonyms of *Aphanius sophiae,* being mostly



Aphanius mento **(after Aksiray).**

nothing more than variations upon condition, age, sex, size, etc. The type locality for *Aphanius sophiae* was Shiraz in Iran (then Persia) but its distribution does extend into eastern Iraq (see figure 1).

The true *sophiae* was imported in 1910 but soon afterward disappeared from the aquarium scene to be imported again only in 1958. However, these later specimens have not been widely distributed among aquarists. A description of this fish (see figure 2) is as follows:

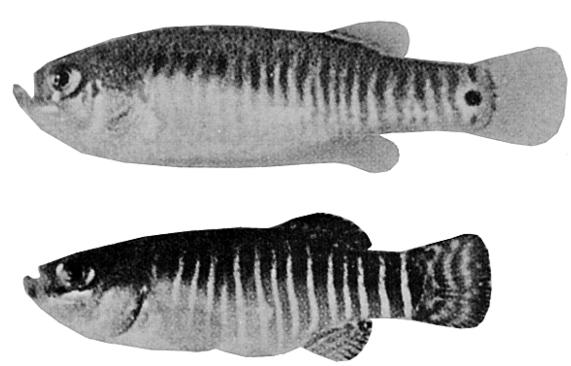
Male - *Olive dorsally, bronze-colored ventrally; from 8 to 19 bluish-silver vertical bands on body; ventral fins pale blue; a number of light and dark spots on bases of fins; dorsal, anal, and caudal with 1 mm wide porcelain-white border; paired fins transparent to yellow-brown.*
Female - *Base color bright, olive-brown; irregular (in number and in alignment) vertical bands, this pattern being similar to ancient runic characters; in the typical case, a sharply delineated spot is present on the tail root; fins colorless except spotted on bases in old specimens.*

This description of a strongly barred fish then, makes it clear that the fish aquarists have been calling *"Aphanius sophiae," is* not that fish at all.

The average length of *Aphanius sophiae is* about 1% inches (total length), although some specimens do reach 2% inches. It does well in hard water of pH 7:5 at a temperature of from 73° to 75° F. When newly imported they can be acclimated in 2% marine water, to which 1 tablespoon of $MgSO_4$ (Magnesium sulfate or Epsom salts) per 6 gallons of water have been added. Then, over a period of time, the fish can be transferred to weaker brackish water and finally, to pure freshwater (but hard). Even in the last solution, however, an addition of 1 teaspoonful of sea salt per 6 gallons (this contains $MgSO_4$) is beneficial.

Aphanius sophiae lays yellowish to clear eggs of 1% mm diameter in mops or on algae. These hatch in from 12 to 16 days, the fry taking brine shrimp nauplii from the start (the fry are easy to raise). The fish may be kept in a community aquarium but not one containing "skittish" or nervous fishes (such as angels), for *sophiae is* always on the move.

This brings us to our last point, viz., "What should we call the fish currently masquerading under false colors?" The answer is, *Aphanius mento* (see figure 3). This fish was described by Heckel in 1843. Unfortunately, a specimen of opposite sex was described by Heckel in the same paper as *"Aphanius cypris,"* but *mento* has page priority and thus, is the correct name to use. Note that *Aphanius mento is* not an Iranian fish but rather is distributed throughout parts of Turkey, Syria, and Palestine (see fig-



Aphanius sophiae**, male below, female above (after Villwock).**

ure 1). The specimens now in the hands of aquarists came from Turkey. *Aphanius mento* has been kept by aquarists for many years now and is the fish currently in the hands of American aquarists. Part of the confusion between the two species arose when the British ichthyologist, Guenther, in 1864, mislabeled some specimens of *mento* from Palestine as *"sophiae." Aphanius sophiae,* however, is not found in that country.

In summary, then, two points have been made:
1. The correct name of the fish now in the hands of American aquarists is *Aphanius mento*.
2. The true *Aphanius sophiae* is a strongly barred fish whose natural distribution is much to the east of that of *mento*.

Finally, I would like to thank Dr. Trewavas of the British Museum, Prof. Steinitz of the Hebrew University (Jerusalem) and Dr. Villwock of the Zoologische Museum (Hamburg), for their kind assistance in properly identifying *Aphanius mento. I* am especially indebted to Dr. Villwock for allowing me to reproduce his original color photograph of the true *Aphanius sophiae.* Dr. *Villwock,* incidentally, is currently considered the leading authority on the classification of *Aphanius* and related fishes.

Not infrequently, when fellow aquarists are cozily arrayed about an open fire and the "fish talk" seems to have halted momentarily, someone asks, "Who are the greatest living aquarists today?" Trust that one to start a lively discussion! Since the pages of the JOURNAL have never been dull, I will venture herewith to propose three names each of which in my opinion, fulfill standards of excellence in at least four specific areas, viz., ability to breed difficult fishes, ability to innovate in the hobby, ability to photograph fishes and ability to write about them. The first two determine the level of the aquarist's skill; the last two determine how well the fruits of such talent are passed on to others. Although it is true that there are hundreds of aquarists who set standards of excellence in any one of these fields, I can nominate from my study of the hobby in all parts of the world, only three who score highly in all four areas.

First and foremost is Col. Joergen J. Scheel of Virum, Denmark, a distinguished Danish Count and military officer. Col. Scheel is one of those real rarities, i.e., an aquarist's aquarist, whose opinions are sought after and respected by the leading hobbyists of the world. Readers of the JOURNAL are to a degree familiar with his carefully researched articles and excellent photographic work (including a cover for the JOURNAL*).* Most aquarists, however, think of Col. Scheel primarily as a killifish fancier but this is only because he is currently doing serious, scientific work in that field (actually, Col. Scheel is an accomplished amateur zoologist). Few Americans, however, know that for years Col. Scheel singlehandedly wrote a monthly aquarium magazine (DANSK AKVARIE BLAD)!

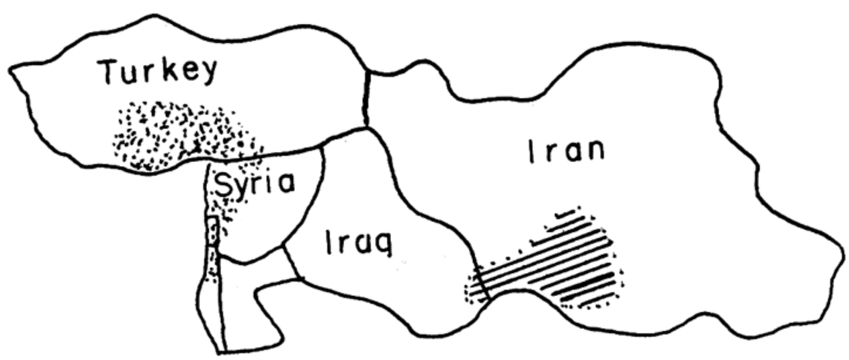


Figure 1. Approximate distribution of two species of *Aphanius*. Key: Dotted area - *Aphanius mento*. Diagonal area - *Aphanius sophiae*.

This work was (and still is) published in looseleaf form so that the subscriber actually receives portions of a vastly comprehensive work on aquarium fishes, plants and related topics. The detail in this work surpasses even the best that we commonly expect from German aquarists. In the field of innovation, Col. Scheel experimented with putting CO_2 into the aquarium when aquarists with a shallower grasp of aquarium equilibria were warning about keeping it out. He introduced the concept of conductivity to aquarists and started his now famous egg membrane studies in fishes. For a number of years, Col. Scheel wrote his "Killie Letters" in which he pioneered many new concepts, and copies of which are now collector's items.

The second on my list is Arend van den Nieuwenhuizen of Heemstede, The Netherlands, a Dutch aquarist of phenomenal ability. Arend is one of the top three aquarists in the world in writing volume but this should not be misconstrued to suggest that the quality is not also high. On the contrary, that he is able to turn out such consistently high quality, detailed material (it has been said of Arend that if one of his fish moves but 1/64 of an inch, he will log it in his data book!) is truly amazing. Furthermore, he is a renowned breeder of aquarium fishes and in areas not considered to be easy, either. For example, he is one of the few aquarists in the world with a "magic touch" in breeding difficult bubblenest builders (e.g., *Ctenopoma)* but he spawns fishes such as spiny eels with similar success. However, it is in the field of aquarium photography that Arend van den Nieuwenhuizen has no peer. In both black and white and color photography, there is no aquarist alive that even comes close to his superb work, be he in this country or abroad. Actually, American aquarists have really seen little of Arend's work, especially his marine fish photography. His genius as a fish photographer is such that not only is HET AQUARIUM*,* the Dutch aquarium magazine, almost completely illustrated by him, but so now also is the famous German aquarium magazine, *DATZ.* He is an innovator and master of action fish photography (incidentally, he is also one of the finest photographers of aquarium plants, amphibians and reptiles alive today) and he has preserved for posterity, his wonderful pictures in the many books he has written. His major book (*Exotische Vissen*), originally written in Dutch, was translated into German and now finally will shortly be available in English. When this happens, his fame as a breeder and a photographer of fishes will go unchallenged throughout the world.

My last nominee is Rosario LaCorte of Elizabeth, New Jersey. "Zar's" work as a photographer (he too, has had a JOURNAL cover!), a writer, and a lecturer are well known to American aquarists but not too many are completely aware of his great ability in breeding the truly difficult fishes. Europeans are amazed at the list of "impossible" fishes he has spawned and raised. His special forte is characins, an extremely tricky field at best. His latest triumph is in spawning *Alestopetersius* but almost any aquarist envies his success with black phantom tetras, emperor tetras, and a host of other balky products of nature's aquatic list. Even here, Zar doesn't just breed the difficult one, he develops them further into recognizable strains. Furthermore, he is to be considered one of the pioneer aquarists in the world in developing new techniques in breeding annual killifishes at a time when virtually nothing was known about them. Truly, visitors to the New York-New jersey area have seen nothing until they have visited his fish house. In my opinion, as a breeder of rare and difficult fishes, he has no equal in this country, and could give the best of foreign aquarists more than a run for their money.

The above are, then, my nominees for the title of "greatest living aquarist." Each excels in the four fields mentioned but even more significant is the fact that they all excel in certain human qualities all too rare nowadays, including humility, an inner warmth and a desire to share life's limited resources with their fellow man.

Zebra Danio Egg Cycles

[Aquarium Journal, April 1964]

To the fish breeder, it would be a valuable achievement to be able to predict the optimum breeding periods for selected species of aquarium fishes. Such ability would enable the hobbyist to schedule his time and resources so as to obtain the maximum number of fry from a given number of species to be bred. It would, in addition, prevent him from wasting his efforts on unsuccessful breeding attempts. A few years ago, I discussed this very same problem in the Swedish aquarium magazine, *Akvariet,* but to my knowledge, it has not been treated in the American aquarium literature.

Now as a prelude to such a predicting ability, it seems clear that we must know whether or not a regulated egg cycle exists within a given species. For some species we do have limited knowledge. For example, *Xiphophorus* and *Lebistes* produce fry at intervals of about 30 days and *Heterandia* at about 5 days. *Oryzias latipes* lays its eggs on a daily basis but many species are known in which periodicity occurs, dependent upon hormones that are similar to those of higher vertebrates. However, experiments have been conducted at the Department of Biological Sciences, Loyola University, to learn whether or not an egg cycle is present in the zebra fish, *Danio (Brachydanio) rerio.*

The investigators (K. K. Hisaoka and C. F. Firlit) had had over 13 year's experience with the zebra fish and observed that they spawned almost always in the early morning, the eggs being laid within 15 to 30 minutes after daybreak. In order to learn something about the minimum recovery time for spawning in this species, female zebras were paired with males by placing a single female into a breeding trap with 3 males during the late afternoon. The bottom of the trap was examined for eggs twice daily (morning and afternoon). The females were separated from their males at certain intervals, depending upon whether or not they had spawned. The results of this particular investigation demonstrated that eggs were never laid on the first, second, third, or fourth day after a previous spawning. However, eggs were laid in large batches every fifth day with marked precision (see Table I).
In order to learn something about the probability of zebra fishes spawning after longer isolation intervals, these experiments were repeated using random isolation times of from 1 to 86 days (see Table II).

Although a minimum of 5 days between spawnings (at 79° F.) was still found to be required, eggs were laid within a period of 5 to 45 days following the previous spawning. After 45 days, spawning upon first contact was almost impossible. Interestingly enough, the

TABLE I

SPAWNING IN THE ZEBRA FISH, *Brachydanio rerio*, WHEN THE TEMPERATURE IS MAINTAINED AT 79°F

Days since last spawning	Number of cases	Spawned?
1	3	no
2	5	no
3	6	no
4	4	no
5	14	yes

TABLE II		
EGG PRODUCTION IN THE ZEBRA FISH AT 79° F		
Days since last spawning	Number of eggs laid	Number of dead eggs
5	600	0
6	300	0
6	349	0
8	512	0
12	851	0
13	1109	213
13	100	0
15	200	
15	528	1055
17	867	0
30	405	107
30	559	119
30	507	124
32	259	0
32	none	
33	336	23
34	none	
35	406	95
45	400	0
72	none	
80	none	

optimum-breeding period during which viable eggs were obtained was from 5 to 10 days after the previous spawning. During this period, the fertilized eggs exhibited little or no mortality. However, both the number of mortalities and abnormalities increased when the eggs were laid after a rest period of 15 days.

The temperature effect upon the egg production cycle was also interesting. When the temperature was raised to 84° F, the minimum time between spawnings decreased to 3 days; at 86° F, this time was only 2 days (see Table III). A number of pairings were also attempted at 72.5° F but even at isolation intervals of up to 36 days, spawning was not observed.

The conclusions are clear enough. Zebra fish are capable of laying eggs at successive intervals of 5 days when maintained at 79° F. In addition, they are also capable of laying eggs upon first contact with males at intervals ranging from 5 to 45 days after the previous spawning (at this temperature). Longer intervals of time between spawnings contribute to increased mortality of the eggs, probably due to over ripening of the eggs. The length of this egg cycle is quite dependent upon temperature, decreasing at higher temperatures and increasing at lower temperatures (egg production ceasing below 72.5° F entirely). These statements, of course, hold only for the conditions under which the fish were kept.

While it is not uncommon to have 1000 fertilized eggs laid at one time by a single female, many zebra fish lay only 100 to 200 eggs at one time. The egglaying potential of this fish is, however, enormous, evidenced by the fact that one female in the study laid a total of 5530 eggs in a period of 5 months! In contrast, the medaka *(Oryzias latipes)* lays but 300 eggs in an entire breeding season.

Aquarium Research & Experimental Institute, British Ichthyological Society, Canadian Aquatic Research Institute, Livebearer Name Changes

[Aquarium Journal, June 1964]

Undoubtedly, one of the more remarkable organizations within our hobby in this country is the Aquarium Research & Experimental Institute of Milwaukee, Wisconsin. To say that it is unique is to understate. It represents a group of talented aquarists who take their hobby seriously, and consequently their investment in both time and money is considerable. Now this is not to suggest that the organization doesn't have fun; on the contrary, it thoroughly enjoys what it does, for in the final analysis all of us must derive some pleasure from the hobby otherwise we would be collecting stamps, bird watching or involved in some such alternative activity.

The Institute was started about 15 years ago by seven aquarists who were dissatisfied with run-of-the-mill aquarium societies. These seven decided to pool their resources and shortly afterwards, rented a 5-room house (sharing, all expenses). Here, they came and went as they saw fit and experimented in many different areas of the hobby. Other aquarists learned of this group and desired affiliation; consequently, the Aquarium Research & Experimental Society (a subsidiary of AREI) was formed. Because of the publication of ARES Reports, it is this latter organization that is somewhat better known throughout the hobby, however.

ARES has a rather formidable organizational structure when compared to an ordinary aquarium society. There are quite definite job descriptions and job titles. For example, one member is known as the "data correlator"; there are "laboratory directors" (the organization has several labs) and there are "instructors" for the numerous courses in aquatic biology offered. All experiments performed, for instance, are numbered and written up, and the more promising are published in ARES Reports. Other publications include Project Reports, Lab Reports and the Catalyst, the last-named a commentary on material appearing in exchange publications, commercial aquarium magazines and the hobby in general.

The experiments performed by ARES are most interesting. One involved the effect of temperature on spinal deformation in a strain of guppies prone to that affliction (conclusion: guppies kept at 72° F produced 5% deformed specimens, guppies kept at 82° F. produced 26% deformed specimens). Another dealt with the use of the proprietary Alka Seltzer in the treatment of *Ichthyophthirius* (conclusion: the tablets were a trifle more effective than Quinine sulfate). At times, theoretical developments are made also. One such analysis concerned the computation of filtration effectiveness which took the hobbyist one step beyond the patently incorrect computation of simply dividing the tank volume by the filtration rate to obtain the time needed to filter an aquarium.

The organization has come a long way since its inception until today, drawings are already made for a third laboratory, which is to be a 35' x 60' cement block building (the land is already paid for). Because of its unique nature, ARES understandably must be somewhat selective in its membership but aquarists interested in its work may subscribe to ARES Reports (charter subscription $3, first year; $1 annual renewal) by writing to ARES Reports, Box 5142, Milwaukee, Wisconsin, 53204.

Another interesting organization is the British Ichthyological Society, designed for the study of amateur ichthyology by anglers and by aquarists. This also is not an ordinary aquarium society by any means for it is devoted to a very board-spectrum study of fishes. One very interesting activity of the Society is its Correspondence Course in the study of fishes. To date, this consists of six parts as follows: Part I - Introductory, Part II - Indigenous Fishes (British Isles, of course), Part III - Whales and related animals, Part IV - Sharks and related animals, Part V - Aquarium fishes and related topics and Part VI - Selected topics in ichthyology (limnology, ecology, etc.). The Society publishes a very excellent bimonthly (The British Ichthyological Journal), which brings together interests shared by anglers and aquarists. Membership in the British Ichthyological Society is $3.00 and application should be made to: Mr. Amil Dillinger, P.O. Box 288, Cassville, Missouri, 65625.

Another organization is of interest to serious aquarists north of the border, the Canadian Aquatic Research Institute. This is a recently formed subsidiary of the Canadian Association of Aquarium Clubs (this is a sort of TIFAS although Canadian clubs are likely to be members of both organizations). The CARI was actually prompted by the success of ARES and the enthusiasm of one of the latter's members, well-known Gene Krys of Milwaukee. Canadians have been quite active organizationally in the hobby recently and even an informal national killifish group has been formed.

Aquarists should take note of several changes in fish nomenclature that affect the hobby significantly. Drs. Donn E. Rosen (American Museum of Natural History) and Reeve M. Bailey (Museum of Zoology, University of Michigan) in their recent monumental treatise revising the livebearers ("The Poeciliid Fishes (Cyprinodontiformes), Their Structure, Zoogeography and Systematics," BULL. OF THE AMER. MUS. OF NAT. HIST., Vol. 126, Article 1, 1963) have transferred the guppy, most mollies, the limias and *Micropoecilia* to the genus *Poecilia* (pronounced, PEE-**SILL'**-EE-AH). Actually, these changes came as no surprise to American ichthyologists since on more than one occasion in the past, the guppy, mollies, etc., were lumped under *Poecilia* in articles appearing in COPEIA, the official publication of the American Society of Ichthyologists & Herpetologists. The new classification makes those occasional guppy x molly crosses more understandable but I imagine that it will be a while before the new nomenclature is mastered by aquarists. Incidentally, the guppy becomes *Poecilia reticulata,* the ending of the trivial name being slightly altered to agree in gender with *Poecilia,* which is feminine.

Speaking of nomenclature, this columnist had an amusing incident along these lines recently. In collaboration with Bruce Turner of New York City, we completed an article on our experiences with a new (to the hobby) killifish for this Journal and duly sent it off to the editorial offices. Some preserved specimens who we thought represented a population from an extreme portion of its range, were sent off to Europe for more detailed examination. Just as the article went to press, we learned that the fish was being transferred to a different genus. Frantically, we recalled the article just in the nick of time. After making the necessary alterations, the article was resubmitted. Afterwards we learned that the preserved specimens sent to Europe represented an entirely new species (which is now being described)! Fearing remarks such as, "Why don't you fellas tie a rubber band to this article?" we elected to present this additional information to the editor in the form of a postscript to our already revised article. However, one more name change and Bruce and I will switch to ants as a hobby!

National Associations, Dwarf Cichlids, *Apistogramma*

[Aquarium Journal, July 1964]

Now that there successfully have been organized two associations dealing with selected aquarium fishes (i.e., AGA – guppies, and the AKA – killifishes; a third, NGS - goldfishes, is somewhat in doubt at this time). One wonders if similar organizations might not also be developed for other fishes. Two possibilities immediately come to mind: bettas and cichlids. The first would most likely resemble the AGA since we are dealing here with variations of a single species (although betta fanciers could conceivably entertain the several other species of *Betta).* A strong goal would be line breeding to perfect selected strains. The latter group would most likely resemble the AKA since it would be concerned with an assemblage of species and the goal of line breeding relegated to a relatively low priority.

At present, this columnist is concerned with sundry species of what are commonly called "dwarf cichlids." Now this term has been bandied about and much criticized but as far as South American cichlids are concerned, it includes most assuredly species of the genus *Apistogramma.* To this we might add *Nannacara, Crenicara* and certain diminutive species of *Aequidens.* When African species are considered, selected members of numerous genera are probably eligible for this designation *(Pelmatochromis, Nannochromis,* etc.). Since cichlid fanciers still do not have any formal organization, this column will devote a reasonable amount of space to these fishes now and in the future.

Recently, I have been asked on a number of occasions how I spawn dwarf cichlids. Although one must always realize that cichlids tend to be individualistic creatures, there are certain standard procedures I follow in attempting to reproduce dwarf cichlids. But these are only my personal, preferred techniques and to suggest that they are the only techniques that will "work," would be to misinform the reader. To continue, then, my choice of tank is either a 3 or 5 gallon stainless steel aquarium, fitted with an inside filter and left with a bare bottom. To this is added either a piece of slate (about 5 x 9 inches), which is leaned against one of the side glasses, or else a flowerpot (or cocoanut shell, three-quarters of one, that is). Frequently, both slate and flowerpot are employed together. The water used is my standard very soft rainwater (I have a cistern) with no regard to pH whatsoever. This is the basic setup, my specific techniques being as follows.

1. Four to five nylon mops (the floating kind, used by the killifish fancier) are added to the tank, followed by the dwarf cichlid pair. How the pair is added is usually of little importance as long as both are added at the same time. If I am unfamiliar with the species, however, the female is sometimes added first, followed by the male in a day or two. This allows the female (who is smaller and weaker) the advantage of adjusting first.

2. Here is a most critical stage, the stage during which most females are killed. If an aquarist loses a female, it is his own fault and no one else's! Without the mops, the female has little refuge in this small tank. Should the male be a vigorous driver and the female not ready to spawn, she simply will be killed (or else severely damaged). The aquarist should check the tank as frequently as possible. He should especially look for the female, asking the following questions:
(a) Is the female hiding in the mops while the male is in full view?
(b) Are the female's fins torn?
The moment one finds the female out swimming around with the male in apparent harmony, then the next step must be taken. My preferred foods for the parents, incidentally, are shredded beef heart and adult, frozen brine shrimp.

3. A thermostatic-heater combination is now added and the temperature brought up to 80-82° F. Again, the admonitions of step 2 are necessary. When the pair is fully adjusted at this higher temperature (i.e., swimming around together in harmony), all but one of the mops are removed.

4. Now watch your fish. An intensive coloration is a sign of imminent spawning as are concerted "cleaning" and "investigative" actions. Watch for the prenuptial play (spreading of fins, jaw-locking, etc.). Look for eggs. However, if a flowerpot is used, you will not always be able to see them unless you disturb the spawning substrate and look inside with a flashlight. This is not recommended. If the fe-

male is in the flowerpot and seems hesitant at coming out and/or if the male acts aggressively toward you, chances are that there are eggs in the flowerpot. Often, these eggs will be laid on the upper (inside) roof of the pot. In the case of slate, they often are laid dose to the bottom of the tank. Cichlids are individuals, however, and they may just ignore all prepared substrates and lay their eggs simply in a corner of the tank!

5. If your fish are fed well but still do not spawn, drop the water level an inch or so, and add cool water (70-72° F.) either right from the tap or from new but aged water (the latter preferred). This often stimulates spawning within two days.

6. Assume now that the fish have spawned . . . now comes a decision. Should the male be removed? Should both parents be removed? In *Apistogramma,* generally only the female cares for the eggs. I prefer leaving both parents in the tank until the eggs are just about ready to hatch. In this way, the female worries about the male and foregoes (sometimes!) eating the eggs. As soon as the embryos are well developed (about 3 days at 80-82° F.), they are out of the most critical fungusing stage. At this point, I remove both parents, mops, inside filter and any other useless equipment. Aeration is maintained, however. More often than not, the pair will eat their eggs and consequently, the next time eggs are laid, both fishes are removed as quickly as possible. Again, all paraphernalia must be removed (except the spawning substrate, of course). At this point I usually add a few cubic centimeters of peat extract and enough acriflavine to color the water a pale yellow. If the parents or even only the female is left with the eggs, I do not add anything.

7. After the fry hatch, absorb their yolk sacs, and become free-swimming (3 days or so), I start feedings or brine shrimp nauplii (with a little egg yolk the first few days). In a week to 10 days, I supply a jug filter (a Miracle drum bowl filter, 1 or 2 gallon size, placed into a plastic sandwich container and covered with gravel). This filters the water without the danger of sucking fry into the filter.

The above steps represent my own personal standard techniques. Again, cichlids are individualistic and when I run into trouble I meet it with personalized action. In my 16 years in the hobby, I have failed in breeding dwarf cichlids in my possession but once using these techniques (the exception was *Lamprologus leleupi* of which, the less said the better … I violated step No. 2!).

Another question I am frequently asked is, "What are the species belonging to the genus *Apistogramma?"* I am not quite sure that anyone knows for certain, but the following partial key might serve as a rough beginning. The "key" does not separate all the species by' any means but it will at least give you an idea of the size of the group.

Incomplete Key to Species of *Apistogramma*

I. MALE WITH LYRETAIL

A. Length of snout greater than diameter of eye:

1. *ortmanni* Eigenmann, 1912 - British Guiana, Amazon
2. *wickleri* Meinken, 1960 - Guianas

B. Length of snout about equal to diameter of eye:

1. *cacatuoides* Hoedeman, 1951 - Dutch Guiana
2. *klausewitzi* Meinken, 1962 - Middle Amazon
3. *ornatipinnis Ahl,* 1936 - British Guiana
4. *sweglesi* Meinken, 1961 - Peruvian Amazon
5. *trifasciatus trifasciatus* Eigenmann & Kennedy, 1903 - Matto Grosso, Brazil
6. *trifasciata maciliense* Haseman, 1911 - Middle Amazon

C. Length of snout shorter than diameter of eye:

1. *borelli Regan,* 1906 - Parana, Gran Chaco, Matto Grosso
2. *ritense Raseman,* 1911 - Parana, Paraguay

II. MALE WITH ROUNDED TAIL

A. Length of snout about equal to diameter of eye:
1. *amblopliltoides* Fowler, 1939 - Peruvian Amazon
2. *steindachneri* Regan, 1908 - Demerara, British Guiana

B. Length of snout less than diameter of eye:
(a) Dorsal rays of male not pro-longed:
1. *aequipinnis* Ahl, 1928 - La Plata
2. *amoenus* Cope, 1872 - Ambyiacu & La Plata
3. *commbrae* Regan, 1906 - Paraguay, Matto Grosso
4. *pertense* Haseman, 1911 - Middle Amazon, Rio Tapajoz
5. *pleurotaenia* Regan, 1901 - La Plata, Paraguay
6. *reitzigi* Ahl, 1939 - Middle & Upper Amazon, Paraguay

(b) Dorsal rays of male prolonged:
1. *ramirezi* Myers & Harry - Rio Meta, Apure
2. *parva* Ahl, 1931 - Lower Amazon, Paraguay
3. *taeniatum* Guenther, 1862 - Amazon to Paraguay

III. MALE WITH PINTAIL

A. Dorsal rays not prolonged:
1. *agassizi* Steindachner, 1875 - Amazon to Parana and Paraguay

A. Anterior dorsal rays prolonged:
1. *weisei* Ahl, 1935 - Middle Amazon

It is hoped that many of these fishes can be described in detail in future articles.

Acestrorhynchus

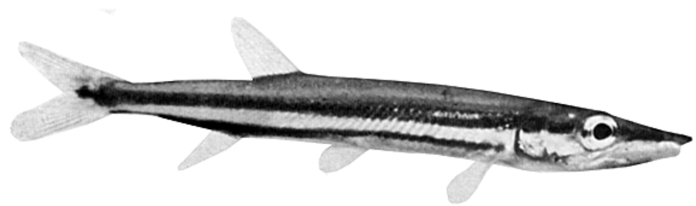
[Aquarium Journal, August 1964]

I must confess to having a weakness for "oddball" fishes but I rather imagine also that it is a weakness shared by many hobbyists. Of course there is always the possibility that such interests represent nothing more than the passing fancies of fads and consequently, the motivation behind them is not particularly praiseworthy. But a true and abiding interest in those fascinating facets of Nature herself is its own justification, and one need not apologize for attending to what is unusual.

This then was the case when I received a specimen of some still unidentified species of *Acestrorhynchus* (let us agree that an acceptable pronunciation of this rather formidable scientific name is AH-SES-TRO-**RIN'**-KUS) from my friend, Jon Krause of Columbus, Ohio (a pioneer in the collection of central Peruvian aquarium fishes). *Acestrorhynchus* is one of the many South American characins, a number of which are predators as other fishes. Some of these have a pike like form and from time to time, have turned up as isolated aquarium specimens. They are, in addition, excellent fishes for public aquaria.

The genus *Acestrorhynchus* features fishes with very long jaws. This scientific name is derived from the words "acestra," which means a darning needle, and "rhynchus," which means snout. A quick glance at the photograph makes the name self-explanatory. Moreover, it is exceedingly appropriate! Fishes of the genus *Acestrorhynchus* are widely distributed throughout South America but because they grow to a large size, seldom are imported. German aquarists, however, have known these fishes since at least 1913. At times, they are caught in their natural habitat in such quantities that they serve as food fishes. It would appear that this would be one dish that carries its own toothpicks! While young, these fishes tend to travel in schools and in British Guiana, are tagged by the natives with fascinating designations such as "Macuse" and "Ghawarrikang."

My own specimen presently is three inches long and perhaps less than one-half inch deep at most. There are two broad, black longitudi-



***Acestrorhynchus* species, as photographed by the author.**

nal bands, the upper one starting at the very tip of the lower jaw, running through the eye, and terminating in a black blotch in the tail.
The lower band actually starts at the tip of the lower jaw and runs into the ventral surface just behind the anal fin, but this band is very light until just after the gill covers. Above the upper band, the fish is brownish; below the lower band it is light brown. However, the area between these bands is gold, a very pretty sight indeed. There is a bright red spot in the upper lobe of the caudal fin and this fin in general is pinkish. For the most part, all other fins are colorless. The upper jaw is somewhat longer than the lower.

Furthermore, they do not meet but rather tend to "gap" in the middle. Here, the needle-like teeth can easily be seen.

My first problem was to decide how to keep the fish. The collector told me that he had had little success in bringing fish like this back alive in the past, and that the three specimens he brought back on this trip represented the zenith of his success. I checked all of my old German reference books and found recommended, a roomy aquarium, shallow water, and lots of heat. Since these were pitifully inadequate observations, I concluded that these authors didn't know much more about the fish than I did (which in itself, was a big "goose egg"). So, I plunked my fish into a vacant five-gallon tank containing soft water at about 75° F.

It appeared to be quite comfortable in these surroundings, hovering motionless about two-thirds of the way to the top of the tank. At first, shredded beef heart was offered and without exception, was refused. Getting desperate, I tossed in some ¾ to 1-inch long *Rivulus hewn* fry and watched carefully. As soon as the fry hit the water, his eye did a quick turn in its socket. However, he made no sudden moves whatsoever. In fact, he did not appear to move at all. One of the *Rivulus* fry about three inches away, started to rise slowly through the water to the surface. Although he did not seem to move any of his fins, the *Acestrorhynchus* slowly oriented himself *so* that his head was pointed directly at the middle of the fry's body. In addition, as the fry rose through the water, so did he. It was as if they were connected by an invisible rod for they maintained precisely the same rate of rise. Then, with a movement that was so fast my eye could not perceive it, my fish had the fry in its mouth. I have never seen a fish move this fast before . . . it was truly amazing.

The *Acestrorhynchus now* had the fry broadside in its mouth, the needle-teeth holding it firmly. In a series of jerking motions, he then eased his victim around so that it was headfirst in its large mouth. Then, in two or three gulps, the fry disappeared. The photograph was taken about an hour before all this took place, and the fish looks hollow-bellied, I know. But not after he gulped down the fry! Now there was a rather large bulge to its stomach. On the first gulp I noticed that the skin on the lower jaw extended, somewhat similar to that of the South American leaf fish *(Monocirrhus)* when it swallows its prey.

I have watched this process many times now, and my *Acestrorhynchus* grows fatter and bigger. Also, *my Rivulus* collection grows smaller and smaller. However, I was able to switch to livebearers, which eased my conscience considerably (killifish fanciers will know what I mean!).

One might be tempted to use the term "vicious" to describe this odd fish but I think that one would mistakenly be introducing purely human standards, to the exclusion of all of Nature's other realistic "rules." *Acestrorhynchus* preys so that it might live. It does not molest fishes that it cannot swallow. It advertises its intentions by its very appearance and this is one quality that dissembling man has yet to attain.

Sterilization of Aquarium Water via Ultra Violet Light

[Aquarium Journal, September 1964]

The aquarist is interested in the sterilization of water primarily for two reasons:

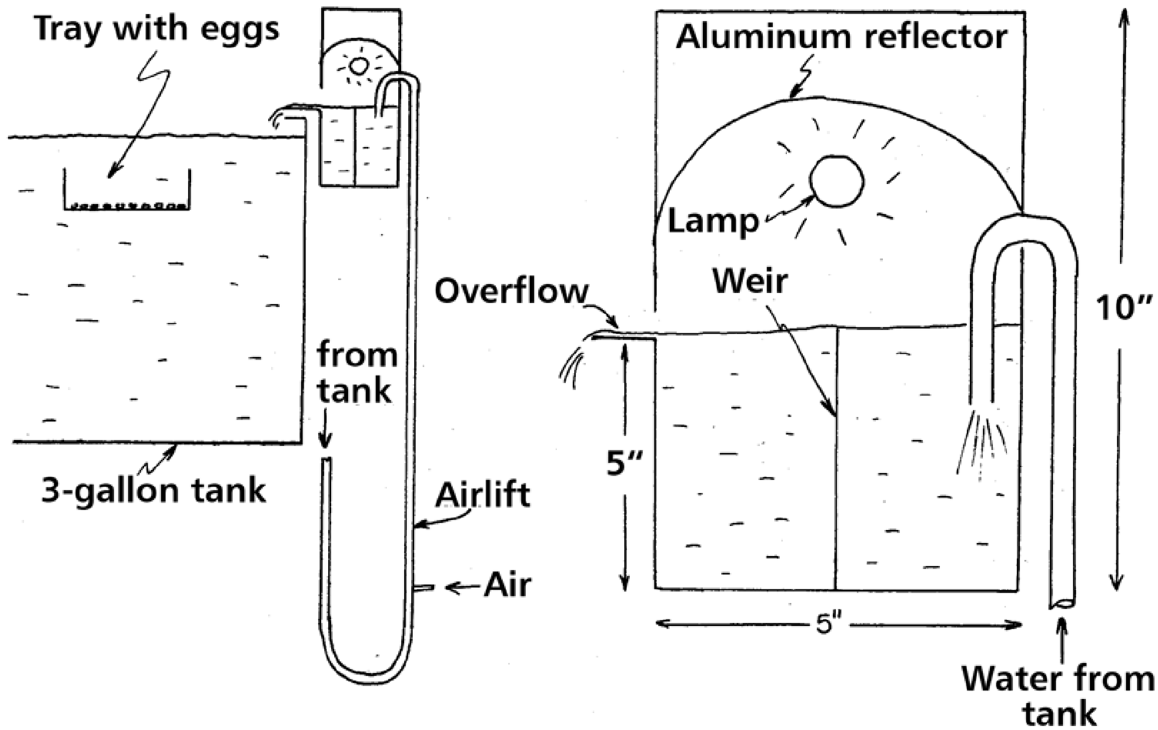
1. The prevention of diseases
2. The protection of fish eggs.

To this end, hobbyists have utilized copper or silver salts for the first, and sundry dyes (e.g., acriflavine) for the second. Recently, ozone has been used also. All of these substances are actively bactericidal but they are toxic to most living organisms to a varying degree and can weaken or even kill fishes (or eggs) when present in concentrations greater than the minimum necessary for sterilizing water. Much skill and care is needed when using these materials.

It therefore was thought advisable to look for a sterilizing agent that would be more acceptable and ultraviolet light appeared to offer many advantages. Since the ultraviolet light would not come into direct contact with either fish or eggs, it could do no damage whatsoever. Ultraviolet light is defined as electromagnetic radiations of wavelength between 40 and 4000 Å (an Å is an angstrom, a measurement of wavelength) but only those in the region of 2500 A are strongly bactericidal. Radiations of less than 2000 Å (particularly those around 1850 Å) can cause the formation of ozone and for aquarium purposes, are not suitable.

Ultraviolet light is readily absorbed by most common materials, ordinary glass and clear plastics, for example, are very opaque to light of this wavelength. Absorption of radiations by air is insignificant. Organic material is highly absorbent but hot water transmits a large proportion of the radiations, the amount falling off with an increase in concentration of suspended materials. Since the average aquarium contains a relatively large quantity of suspended organic material, it was thought that the best preliminary application of ultra-violet light to aquarium water would be in the hatching of fish' eggs since clear water could be used with little difficulty.

Although hobbyists are quite familiar with the incandescent-type of ultra-violet bulb found in many refrigerators (used for sterilization of food), this type of bulb is not very satisfactory for use by the aquarist. Fortunately, a strip lamp type of ultraviolet light is available, similar to the ordinary fluorescent type. The lamps used in these investigations were of General Electric manufacture (these had to be ordered through an electrical supplier) numbers G-15, T-8 and G-8 T-5. The former is a medium bipin, 18 inches long, 15-watt lamp; the latter is a miniature bipin, 12 inches long, 8-watt lamp. Both of these lamps are simply mounted into the standard socket, ballast, starter, etc. setup for ordinary 15 or 8-watt fluorescent lamps. The output of both lamps is in the desired 2500 Å range. It must be mentioned that certain commercial "blacklight" units emit rays nearer to the 4000 Å range and thus, are not suitable for use in sterilization of aquarium water. There is available also a 30 watt GE lamp but this was not used in this investiga-



tion. If one has never seen ultraviolet lamps before, they are like fluorescent lamps but the glass (a special kind) is clear. The costs for my lamps ranged for $4 to $7 (depending upon wattage), the standard ballast, starter, etc. setup costing a few dollars more.

The effectiveness of ultraviolet light is dependent mainly upon three factors, viz., the absorption coefficient of the water type itself, the depth of the water and the length of time the water has been exposed to the light. The first two factors are nicely illustrated in Table I.

The depth effect is not linear, i.e., the transmission of ultraviolet light is a losing proposition as we go deeper and deeper (the transmission is actually exponential in nature). Furthermore, Table I shows the effect of increasing amounts of organic materials in the water. In a dirty aquarium, ultraviolet light is stopped very near the surface of the water. There is no great decrease in the transmission factor when common minute impurities of water (e.g., calcium chloride, calcium carbonate, calcium sulfate, magnesium chloride, magnesium carbonate, magnesium sulfate, sodium chloride, sodium carbonate, sodium sulfate, aluminum oxide) are added to distilled water in reasonable quantities, say 1 to 100 ppm. Thus, hardness or softness of the water is not important. A significant exception, however, is iron oxide. Even 1 ppm iron oxide added to distilled water, decreased the transmission faster from a previous 92% to 27% at a depth of five inches. Another example illustrates this dramatically. A steel tack was placed in a pint of water drawn from a cold-water tap. After 72 hours, the transmission factor at a five-inch depth decreased from 53 to 19%!

The flow of water needed to effect a given percentage kill of common aquarium water bacteria is given in Table II.

These rates are not unreasonable, especially for the smaller water depths. Therefore, a design was selected to minimize this depth (see figure). A box was constructed, 5” x 10” x 14”, housing the ultraviolet lamp (8 watts) and

TABLE I				
Source of water	Absorption coefficient	Percent Transmission at Given Depth		
		3 in.	6 in.	12 in.
distilled	0.24	92	88	78
swimming pool	0.94	78	62	3
Cleveland tap water	1.52	67	46	22
well water	1.72	64	42	18
aquarium water	2.14	58	34	12
Lake Erie	2.53	52	28	8
cistern water	9.05	10	1	0

its auxiliaries, plus a weir and an overflow lip. This device was hung on a 3-gallon tank using stainless steel straps. The box (especially the lower portion) was made watertight by the use of fiberglass resin. An aluminum reflector was used and the box itself was fitted with a single airlift of the Halvin Filterfast type (rate about 20 gallons per hour) to bring water from the tank to the box. Thus, the water passed over the weir in a thin sheet to get to the overflow lip and out into the aquarium again. No filter was used with this setup. The tank contained a nylon basket (fine mesh) in which killifish eggs *(Pachypanchax playfairii, Aphyosemion multicolor and Aplocheilus panchax) were* placed.

A problem was encountered in that ultraviolet light leaked" from the box (via the overflow) to the eggs in the tray. This was solved by using a dark cover (plastic) over the. 3-gallon tank with a slot for the overflow from in the box. However, a later model baffled the overflow so that little light leaked onto the eggs. Another problem was in ventilating the box since the lamp gave off some heat. This was difficult to do without letting some of the light out but again, baffling solved the problem. It is important that neither eggs, fish nor the aquarist himself be exposed to ultraviolet light for any length of time. I do not dwell too much on my designs as to date, they have been quite crude, and it is certain that readers will be able to improve upon them considerably.

The results were excellent. Very few eggs fungused. Furthermore, unlike with the use of dyes, the hatching of the eggs when fully developed was not impeded. When the embryo was adjudged dark enough, the egg was removed with an eyedropper to a shallow container holding some old aquarium water. Not being dyed, the eggs hatched nicely. In some cases, "forced hatching" via addition of pow-

TABLE II			
RATES IN GALLONS PER HOUR FOR INDICATED KILL, 15-WATT LAMP (8-WATT IN PARENTHESES)			
Depth of Water	90% Kill	99% Kill	99.99% Kill
1/4 inch	48 (144)	24 (72)	12 (36)
1/8	24 (72)	12 (36)	6 (18)
1/16 inch	12 (36)	6 (18)	3 (9)

dered dry food was necessary. The point is, however, that the ultraviolet radiation kept bacterial damage to a minimum. If an egg fungused, however, the radiation did not kill the fungus although it was noted that it retarded its growth markedly. So that it is not thought that experiments were done with killifishes only (the eggs of which I happened to have on hand in quantity), the basket was removed and a pair of zebra danios *(Danio rerio)* was spawned in the tank. None of the eggs fungused.

A very similar unit was constructed, this time using the 15-watt lamp plus two airlifts. This unit (rather bulky) was hung on an 8-gallon aquarium in which dwarf cichlids *(Apistogramma agassizi)* were spawning. Actually, the unit was "on stream" two weeks before the eggs were laid. After the eggs were deposited (on slate), the parents were removed. Unlike the 3-gallon tank, this aquarium had independent filtration which was left on until the tails of the fry were out, at which time also the lamp was turned off. Again, bacterial damage was minor.

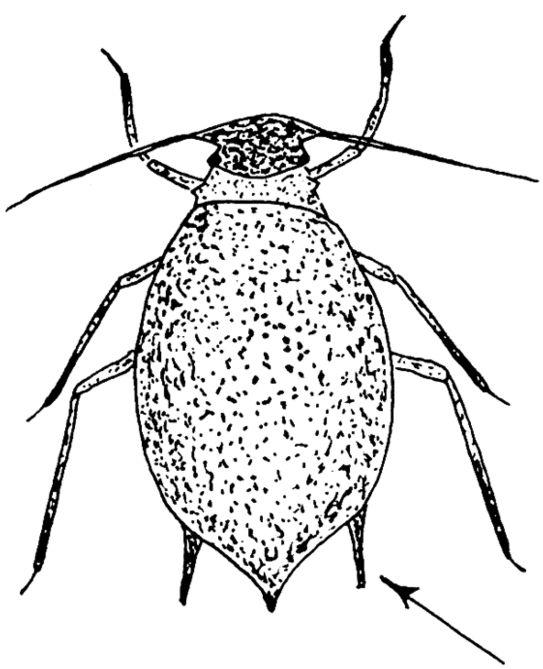
It remains to be seen how effective the use of ultraviolet light would be in preventing diseases and I rather imagine that this would be difficult to prove anyway. However, its efficacy and usefulness in the hatching of fish eggs is amply demonstrated and should prove an interesting project for aquarists who like to experiment.

The Aphid—A Plant Destroyer

[Tropicals Magazine, Christmas Gift Issue 1960]

Some time ago, I learned how the father bear must have felt when he came home and said, "Someone has been nibbling at my porridge!" In my particular case, someone had been nibbling at my aquarium plants and it wasn't long before I discovered the culprit. To me, said culprit looked merely like a bug and indeed, it later turned out that "bug" was a valid scientific term for this creature.

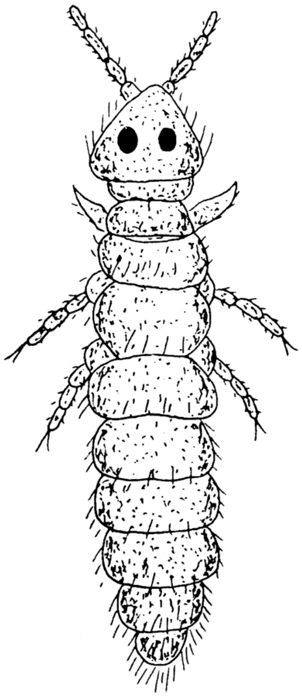
First, however, a word about the modus operandi of this little pest. Fortunately, only those parts of floating plants that lie on the surface or protrude above it are attacked. In the infested aquarium in question, this meant mostly giant Vallisneria *(Vallisneria gigantea)* but also included the floating leaves of the ruffled sword plant *(Echinodorus martii)* and *Aponogeton undulatus.* Holes were made in the leaves of these center plants but in the case of the val, the leaves were nibbled all the way across, resulting in long, detached floating pieces of the plant. The photograph shows a detached leaf together with a number of the parasites.



An aphid, the Green Apple aphid, *Aphis pomi*. The arrow points to a cornicle.

After detailed examination, I established that the responsible insect was a member of the aphid family. Coincidentally, I happened to scan a reader's letter in an issue of the German aquarium magazine, *"Aquarien and Terrarien,"* and found that he and a number of his friends were having trouble with what appeared to me to be the same parasite. Thus, an interesting exchange of correspondence resulted. One thing was peculiar, however, in that the insect of the Germans was capable of jumping — mine were not. Mr. Walter Papenbrock, a distinguished aquarist and specialist in the micro life of the aquarium (Mr. Papenbrock is a resident of West Berlin) advised me that their problem was with an insect belonging to the springtails. This was quite a surprise to me for the following reason. The class of insects is usually divided into two subclasses:

INSECTS →	*Apterygota* - Wingless and have descended from a wingless ancestry.
	Pterygota - most adults winged. If wings are absent, this is an indication of loss, not of a primitive condition.



A springtail, the Snow Flea, *Achorutes nivicola*.

The second subclass comprises the majority of insects. One of the orders of *Apterygota is Collembola,* commonly known as the springtails. These are minute insects, rarely exceeding 5 mm in length. Their mouthparts are for chewing and are withdrawn into the head so that only the tips are visible. Some, of course, are injurious to plants. Also, many of them can jump. A typical species is illustrated (the snow flea, *Achorutes nivicola).*

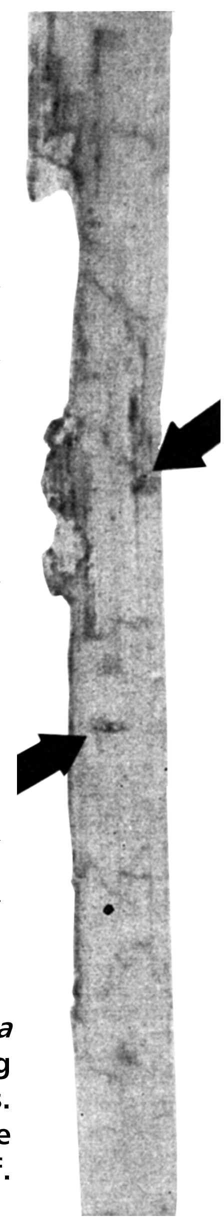
Turning now to the *Pterygota,* we find the order, *Hemiptera,* or the bugs. The bugs have true piercing mouthparts. Winding our way down the many families of this order, we finally come to the *Aphididae or* plant lice. Here, the hind legs are not fitted for jumping as in the springtails (there is a closely related family, however, *Chermidae* or jumping plant lice, with hind legs enlarged and fitted for jumping).

Fearing that I may have erred in my identification, I shipped a number of the parasites off to Mr. Pappenbrock for careful identification. He discovered all to be aphids except one specimen, and this turned out to be a springtail! Thus, I really had two parasites to contend with although one was strongly in predominance. This was remarkable since both insects are so far apart in their relationship.

Aphids are small (1 to 6 mm), more or less pear-shaped and are either winged or wingless according to the species or to the phase of development within the species Most aphids are characterized by a set of cornicles or tubes (see illustration). They are commonly called "honey tubes" from the belief that honeydew is excreted through them (this is not true, however, as honeydew is secreted from the anal opening - the cornicles secrete a protective wax). The biology of the aphids is extremely complicated and the life cycles of only a few are known.

Aquarium chemicals do not affect aphids or springtails. DDT, of course, does but even in very dilute solutions, DDT is highly toxic to fishes. I have found that black ruby barbs, at least, will eat aphids but only when they are removed from the plants and dropped into the water as food.

Aphids are air breathers and, as such, are always on the topside of a floating plant. Here the fish cannot reach them. The only effective control method I have found for these pests is drowning. A pane of glass, wood, card-



Leaf of *Valisneria gigantea* showing damage by aphids. Arrows point to two of the aphids on this leaf.

board, etc., is lowered onto the surface of the water and then slightly under. If trapped air is released, the aphids or springtails drown in a few hours. Several repetitions are needed before all of the pests are dead but the method works well. I have suggested this control method to German aquarists and they report success. The method is simple and there is no danger to the fish population.

An Apparatus for Fungus Prevention of Killifish Eggs

[Tropicals Magazine, Holiday Issue 1961]

A common difficulty in raising killifishes is the prevention of the developing fish eggs from bacterial or fungus destruction. This problem, by the way, is not unique to killifishes alone but by virtue of a long (relatively) development time, it is intensified with these fishes. We aquarists have a number of possible approaches to this problem and, as ably listed by Dr. Thomas Calahan, these are:

1. Acidity
2. Salinity
3. Drugs (antibiotics, dyes, etc.)
4. Air
5. Isolation

I would, perhaps, have to admit that most hobbyists try to solve this problem via the use of such dyes as acriflavine, methylene blue, malachite green etc., although experienced killifish fanciers appreciate control of the first two factors, acidity and salinity (salinity here referring to any salt concentration).

Isolation, in the form of storing single eggs in individual vials, has been used for years and recently reintroduced in the form of storing eggs on a moist nylon surface (see TROPICALS MAGAZINE, May-June 1959). Actually, this latter technique is akin to storing eggs in damp peat moss, a favorite of German aquarists. Isolation techniques are particularly attractive to hobbyists specializing in the soil-breeders or annual fishes.

The use of air is commonly seen in commercial fish hatcheries (trout eggs and others) but hitherto has found service among aquarists only with non-killifish fishes such as cichlids. At this point, I should like to summarize my experiments with killifish eggs and air. It became apparent during trials in raising eggs of the plant breeders that drugs had much less effect on the percentage egg hatch than did careful adjustment of acidity and salinity. Nevertheless, with all three as controlled factors, eggs would still spoil. It was obvious that the real problem was not to prevent this or that egg from deterioration, but rather to prevent the spread of such destruction to neighboring eggs. Such spread soon reached epidemic proportions and, as a consequence of a few had eggs, all or most would spoil. I was not interested in the controversy over whether fish eggs are attacked first by bacteria and only then by fungus, or whether fish eggs can be attacked directly by fungus. I think that the end results are mutually unacceptable.

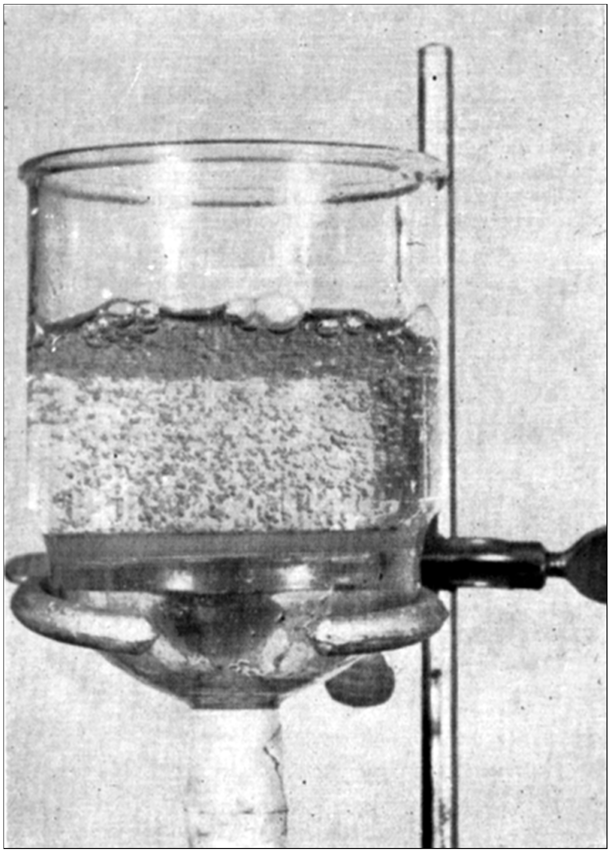
From observations, most aquarists will agree to the following chronology of fish egg spoilage:

(a) The eggs turn white (bacterial infection),
(b) Fungus filaments appear.

I have, however, observed the following:

(1) When a fish egg affected by bacteria (turned white) is placed touching a viable egg, the bacterial infection spreads to the good egg. The infection starts as a pinpoint at the point of contact and soon spreads throughout the egg. All this can happen, however, without any fungus growths being apparent.

(2) When a fungused egg (filaments streaming from the egg) is placed touching a viable egg, the fungus growth spreads to the good egg.



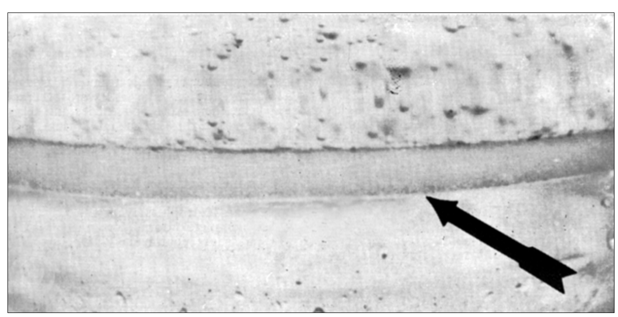
The apparatus in action! Note the vigorous but well-distributed air action. There are fish eggs (*Aphyosemion calliurum ahli)* present in this apparatus but they cannot be distinguished from the fine air bubbles. Photo by Albert J. Klee

In either case, isolation of the eggs is indicated for solution of the problem. After reflection, however, it will be realized that eggs can be, in effect, isolated while in a crowd provided the crowd is moving! Therefore, some apparatus must be devised to move the eggs. Air immediately comes to mind but the practice of placing an air stone in a container proves unsatisfactory since there are areas of calm amidst turbulence in such a set up.

There is, however, an item of equipment already on the market that is so designed to overcome this obstacle. I refer to the filtering funnel, with sintered glass filter plate, of the chemist (see Figure 1). Such a device, when used in reverse of its intended purpose, distributes air throughout the water almost perfectly. In addition, the air bubbles are small and numerous. By drilling a cork to accept an airline, and placing this in the stem of the funnel, the aquarist has an effective device for the prevention of the spreading of fungus and bacterial infections among fish eggs. Merely fill the funnel with water, turn on the air, and observe the vigorous and well-distributed action. The sintered glass plate does an effective job (see photo), and being all-glass, is easily cleaned and sterilized. The funnels are available in several sizes at any laboratory supply house. They are relatively expensive but an amazing number of eggs can be accommodated at one time.

The apparatus is used as follows:

1. Fill the funnel 2/3rds of the way with water from the breeding aquarium. Note! Take the same care with acidity and salinity as you would normally.
2. If you desire, add a few drops of dye or antibiotic. This is not necessary, however. As a matter of fact, the highly oxygenated water quickly destroys any organic chemical added to the water.
3. Cover the funnel with a glass square and turn on the air. The action should be vigorous but not violent (see the illustrations).



A close-up of the bubbling action. The arrow points to the sintered glass plate. This plate acts like a continuous disk-like airstone. Photo by Albert Klee.

4. Every day (or other convenient interval), shut off the air and wait for the eggs to settle to the bottom. If properly maintained, you will never find fungused eggs, however, bacterially affected eggs may be found and thence removed. Note the developing embryos in eggs that have been in the funnel for some time. When these eggs show a dark, well-developed embryo, remove them to a hatching container (I use a shallow container with powdered, dried aquarium plants sprinkled on the surface to facilitate dissolution of the egg shell). Do not let the fry hatch out in the funnel! They will be killed in a few minutes. After spoiled eggs and imminent-hatching eggs are removed, restart the air.

5. Evaporation losses (of water) are high and replacement should be made with distilled water to prevent salt buildup. I use the water from a dehumidifier unit.

With this device, I do not have fungus problems with the plant breeders any more. \Some eggs may spoil from bacterial causes but the deterioration does not spread from one egg to another. In addition, the developing eggs are well oxygenated and all fish eggs require oxygen during this period. The equipment is simple to operate and takes little of the aquarist's time. I do not use the apparatus on annual fish eggs because of the necessity for partial drying of these eggs during development, but all of the eggs of my plant breeders and even some eggs of other fishes (for example, cichlid eggs, however, these eggs stick together and more experimentation is needed here) currently go through this apparatus.

An Unusual Tribe of Characins

[Tropicals Magazine, Fall-Buyer's Issue 1961]

Sexual dimorphism is like antimacassar - few people can define it, but when it is de-fined, it turns out they knew what it was all the time. Give up on antimacassar? Well, it is a doily-like cover used to protect the back or arms of a chair or sofa. Give up on sexual dimorphism? Well, by sexual dimorphism we mean simply, given a certain species of fish, that one sex differs in external form or shape from the other, or else possesses some singular external feature by which easy differentiation may be made. Thus, for example, aquarists recognize

I. ***Adipose fin absent***	
A. Spoon-shaped structure originating from gill covers of the male	***Corynopoma***
B. Spoon-shaped structure originating from a scale on the Back of the male	***Pterobrycon***
II. Adipose fin present:	
A. Posterior border of the gill cover indented, lowest part ending in a point	***Diapoma***
B. Gill cover not indented:	
1. Breast region axe or wedge-shaped, as in the hatchet fishes. Dorsal and anal fins of the males have elongated fin rays	***Pseudocorynopoma***
2. Breast region rounded, not wedge-shaped:	
(A) A number of rays of the lower lobe of the tailfin covered by a scaly pocket:	
(1) Anal fin long (30-34 rays)	***Gephyrocharax***
(2) Anal fin short (only 18 rays)	***Microbrycon***
(B) Scale-like gland on both sides of the tail:	
(1) On the upper lobe	***Mimagoniates***
(2) On the lower lobe	***Hysteronotus***

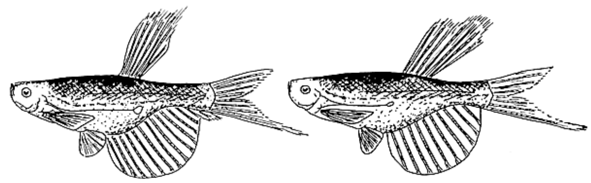


Figure 1: LEFT: *Corynopoma aliata* RIGHT: *Corynopoma riisei*

sexual dimorphism in livebearers. Among other things, the gonopodium of the male fish is a dead giveaway. In some groups of fishes, sexual dimorphism is present but not always easy to recognize. One has to look hard, for example, to detect the elongated fins of a male cichlid. In general, few characins exhibit sexual dimorphism. However, there is one tribe of characins that does - this is the tribe, *Glandulocaudidi,* one of the many tribes of fishes in the characin family. This is not its only distinguishing feature, however, for one of the strangest modes of reproduction known in egglaying fishes is characteristic for this tribe - more will be said about this later. The following key will serve to introduce the genera of this tribe.*

Of these eight genera, all but *Diapoma* and *Hysteronotus* have contributed species to the aquarium.

Two species of *Corynopoma* are known to science: *Corynopoma aliata* and *Corynopoma riisei,* the latter fish being known popularly as the swordtail characin. There is very little difference outwardly between these two species; however, *C. aliata* does have the last few rays of its anal fin (in the males) elongated (figure 1). *Corynopoma riisei* appeared as an aquarium fish in 1932 and has remained popular ever since. There is some doubt as to whether or not *Corynopoma aliata* has ever been used as an aquarium fish. If it has, it most likely has been considered as the other well-known species.

There is an interesting aside on the story of the swordtail characin's scientific name. In 1858, Gill (a famous American naturalist) described four new fishes: *Stevardia albipinnis, Corynopoma riisei, Corynopoma veedoni,* and *Nematopoma searlesii. Six* years later, in 1864, Albert Guenther of the British Museum determined that all four fishes were merely age and sex variants of the same species! Accordingly, Guenther picked the name, *Corynopoma riisei,* for the species. This points up very well an incidence of sexual dimorphism in fish.

The males, by virtue of their "spoon" or "paddle" (the generic name, *Corynopoma,* means, "gill cover with club"), differ markedly from the females. More will be said about this organ later. *Corynopoma aliata* originates in streams at the foot of the Andes mountains in South America, and ranges between these mountains to the east of Bogotá, Columbia. *Corynopoma riisei* comes from Trinidad, Columbia and Venezuela; in fact, from the whole flood basin of the Orinoco River.

In a number of instances, the single *Pterobrycon landoni,* has been imported as an aquarium fish. It is rare, however, and is pictured only to show its resemblance to the more familiar swordtail characin (figure 2). It is found in the Altrato flood basin in South America. Again, its sexual dimorphism is quite apparent, the females lacking the elongated fins of the male and any peculiar extensions from the body. In

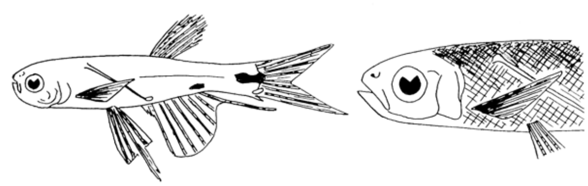


Figure 2: *Pterobrycon landoni* and sketch showing details about head region.

***Some ichthyologists classify this group as a subfamily, the *Glandulocaudinae.* In this article, Dr. Hoedeman's classification scheme will be used.**

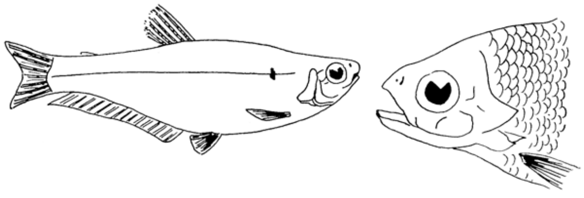


Figure 3: LEFT: *Diapoma speculiferum.* RIGHT: Close-up of head showing spur on gill cover.

the males, the "paddle" originates from a scale located on the back and to one side of the fish, rather than originating on the gill cover.

To my knowledge, the one species of *Diapoma* known to science has never been imported as an aquarium fish. The fish *(Diapoma speculiferum) is* illustrated, however, in order to complete the picture of this tribe (figure 3). Note the peculiar indentation and spur on the gill cover (the generic name, Diapoma, means "gill cover divided into two parts"). This fish is from the Rio Jacuhy and Rio Grande do Sul.

Two species of *Pseudocorynopoma* are known and both have been imported as aquarium fishes: *Pseudocorynopoma heterandria* (imported in 1935) and *Pseudocorynopoma doriae* (imported in 1905). The latter fish, which hails from a wide region in South America, is popularly known as the dragon fin. To some extent, these fishes resemble the hatchet fishes. *Pseudocorynopoma doriae,* with its magnificent finnage, outshines its cousin although the latter does have an interesting pronounced ventral keel (figure 4). The sexual dimorphism of these two species is as pronounced as it is in the swordtail characin. The females simply do not have the elongated finnage of the males; also, the caudal fin of the males is split to the root. *Pseudocorynopoma* species have an adipose fin, as do the species that follow. In general, these are rather large fishes for aquarium characins (almost 3-1/2 inches). Both species have a peculiar scrofulous-like or glandular organ on the lower lobe of the tail fin (figure 4).

Gephyrocharax has contributed two of its seven known species to the aquarium world: *Gephyrocharax atracaudatus* and *Gephyrocharax valencia (figure 5).* The former, imported in 1933 from Panama, is commonly known as the platinum tetra. The latter, from Lake Valencia in Venezuela, was imported a year earlier. The Germans sometimes call these species, "bridge salmlers" or "bridge tetras," since the genus *Gephyrocharax* does form a connecting link between the *Glandulocaudidi* (a tribe in the subfamily, *Characinae)* and the subfamily, *Cheirodontinae* (both Characinae and *Cheirodontinae* are subfamilies of the family, *Characidae).* The nomenclature used here is that of Dr. Hoedeman. In any event, the two species are differentiated by virtue of the black markings in the tail of *atracaudatus*, absent in *Valencia* except at the root. A peculiar scaly pocket covers a number of rays of the lower lobe of the tail fin and, in addition, a spur is present below the lowest ray of this fin (present only in the males). In general, one must look hard to detect these appurtenances. However, they are easily observed on dead specimens. To an aquarist, therefore, the sexual dimorphism is not readily apparent.

Our single aquarium representative of the *Microbrycon* genus is *Microbrycon cochui,* imported about 1949 from the Amazon region of

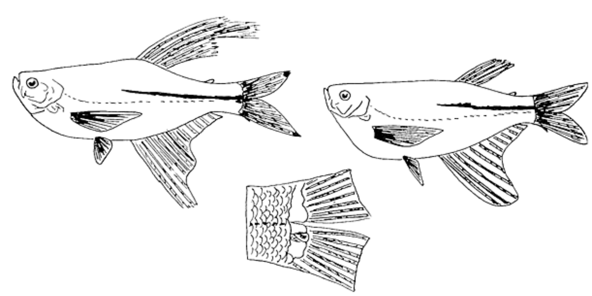


Figure 4: LEFT – *Pseudocorynopoma doriae.* RIGHT – *Pseudocorynopoma heterandria.* BELOW – Glandular organ on tail of *Pseudocorynopoma.*

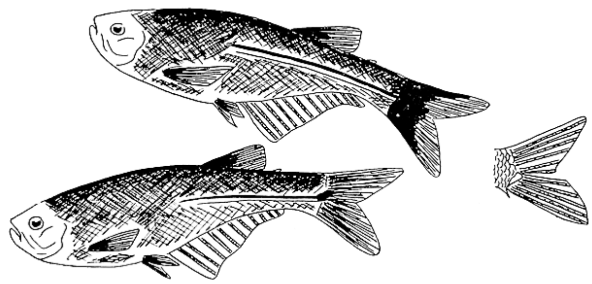


Figure 5:
TOP – *Gephyrocharax atracaudatus.*
BOTTOM - Gephyrocharax valencia.
RIGHT - Close-up of scaly pocket and spur on tail.

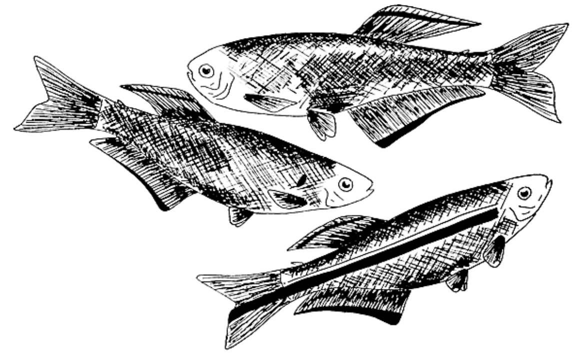


Figure 7. TOP - *Mimagoniates inequalis*
MIDDLE - *Mimagoniates microlepis*
BOTTOM - *Mimagoniates barberi*

South America. Again, the sexual dimorphism is rather obscure. This is a diminutive species, about 1-1/3 inches in length. The genus differs from *Gephyrocharax* in that the former has a relatively shorter anal fin (figure 6). Although the sexes are similar (except for the usual plumpness of a ripe female), the scaly pocket of the males can be seen with a low-power magnifying glass.

Our last aquarium genus is *Mimagoniates*, supplying us with the following fishes: *Mimagoniates barberi* (imported 1907), *M. microlepis* (the blue tetra, imported 1907) and *M. inequalis* (the croaking tetra, imported 1926). These fishes are found in Brazil and farther south to Paraguay. Until relatively recently, *Mimagoniates inequalis* was known as

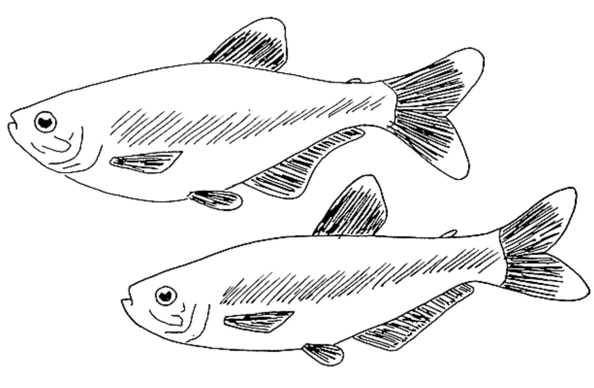


Figure 6: *Microbrycon cochui*
(female above, male below).

"*Glandulocauda inequalis,"* however, Dr. Schultz of the U.S. National Museum revised the genera and corrected the name (the term, *Glandulocauda,* from which the tribe gets its name, means "small gland on tail"). *Microlepis* and *inequalis* are similar in coloration but very different in shape. At one time or another, both have been labeled as "blue tetra," although this popular name is more frequently used with *Mimagoniates microlepis. Mimagoniates barberi is* similar in form to *M. microlepis* but the former is heavily pigmented, very dark-colored, and very beautiful (figure 7). In the *Mimagoniates* species, there is a scale-like gland on both sides of the tail in the males. This is located at the base of the tail, somewhat higher than its middle. It forms a sort of pocket or hollow near this upper tail lobe. However, due to the heavy pigmentation in this area, this structure is difficult to see. Another peculiarity of this genus is the fact that they
are, to some extent, air breathers! All of them make clicking noises as they come to the surface to swallow an air bubble. The noise they make is such that one of them
(Mimagoniates inequalis) has been popularly called, the croaking tetra.

Of course, no attempt has been made here to really describe all of these species. What has been intended is an introduction to an out-

standing peculiarity of the group, viz., sexual dimorphism. However, there is another peculiarity possibly even more outstanding . . . this is the fact that many of these fishes, egg layers all, are capable of internal fertilization!
In the 1930's, it was discovered that females of certain of the *Glandulocaudidi* were able to lay fertile eggs. This was proven true for *Mimagoniates inequalis,*

M. barberi, M. microlepis, Corynopoma riisei, Gephyrocharax Valencia, and *G. atracaudatus.* To my knowledge, this has never been proved to be true for species of *Pseudocorynopoma* ... certainly enough information has been collected on this fish to safely say that it does not fertilize eggs internally. About *Microbrycon cochui,* little is known. Perhaps this fish fertilizes internally, however, I have no firsthand information to decide the issue once and for all.

In the case of the *Mimagoniates* species, the spawning pair twists around each other much in the manner of bettas - such is the flexibility of their spine at these times! Sometime during this act, a "packet" of sperm passes from the male into the vaginal opening of the female. The packet releases sperm over a period of time, enabling eggs to be fertilized sans presence of any male fish. Fertilized eggs can be laid weeks after contact with a male *Mimagoniates*. Nothing is known about how the sperm package arrives in the female's duct. Similar remarks hold also for species of *Gephyrocharax*.

Since the swordtail characin *(Corynopoma riisei) is* a fairly common fish, much discussion has been held about its technique of internal fertilization. Special thought has been given to the role of the "paddles" during spawning. In some quarters, it has been thought that they are connected with the passing of the sperm package to the female, in spite of the fact that *Mimagoniates* and *Gephyrocharax* species do not possess such organs but still are capable of internal fertilization. It is true that, during the spawning act, these paddles become enlarged and stand out from gill covers; also at this time, the ends of this organ take on an almost blackish coloration. My own observations are, however, that the corynopomas or paddles do not touch the sperm package in any way.

After observing many spawnings, I have come to the conclusion that direct contact is made between the sexual openings of the spawning pair. Again, like bettas, the male twists about the female, touching her frequently. In particular, the anal fin of the male is cupped over the female's body. To effect a transfer, cooperation must exist between the two fish, but not inordinately so. It is true that not all tries are successful. If one is quick, the misses are readily observed as a whitish ball about three times the size of an egg floating down to the bottom. This is the spermatophore, containing thousands of sperms. There does not seem to be a membrane holding this structure together—rather the sperm is cemented into a sort of jell-like mass that dissolves only after entry into the uterus of the female. R. E. McDonald has described the process as firing "cannon fashion," but I think this is too strong a term. In firing a cannon, there is no cooperation between artillery and target; in the case of the swordtail characin, there definitely is. The two fish remain together for many seconds at a time, affording opportunity to transfer the spermatophore. To my thinking, there really is no mystery at all.

Female swordtail characins are able to lay fertilized eggs up to 10 or 12 months after contact with a male, although this is a bit unusual. Apparently, the spermatophore dissolves slowly and the sperms somehow manage to stay alive. How this is done is the real mystery. Personally, the internal fertilization of the *Glandulocaudidi* is one of the fascinating aspects of our hobby.

I. Adipose fin absent
A. Spoon-shaped structure originating from gill covers of the male - *Corynopoma*
B. Spoon-shaped structure originating from a scale on the back of the male - *Pterobrycon*

II. Adipose fin present:
A. Posterior border of the gill cover indented, lowest part ending in a point - *Diapoma*
B. Gill cover not indented:
1. Breast region axe or wedge-shaped, as in the hatchet fishes.
Dorsal and anal fins of the males have elongated fin rays - *Pseudocorynopoma*
2. Breast region rounded, not wedge-shaped:
(A) A number of rays of the lower lobe of the tailfin covered by a scaly pocket:
(1) Anal fin long (30-34 rays) - *Gephyrocharax*
(2) Anal fin short (only 18 rays) - *Microbrycon*
(B) Scale-like gland on both sides of the tail:
(1) On the upper lobe - *Mimagoniates*
(2) On the lower lobe - *Hysteronotus*

The Breeding and Larval Development of the *Callichthyinae*

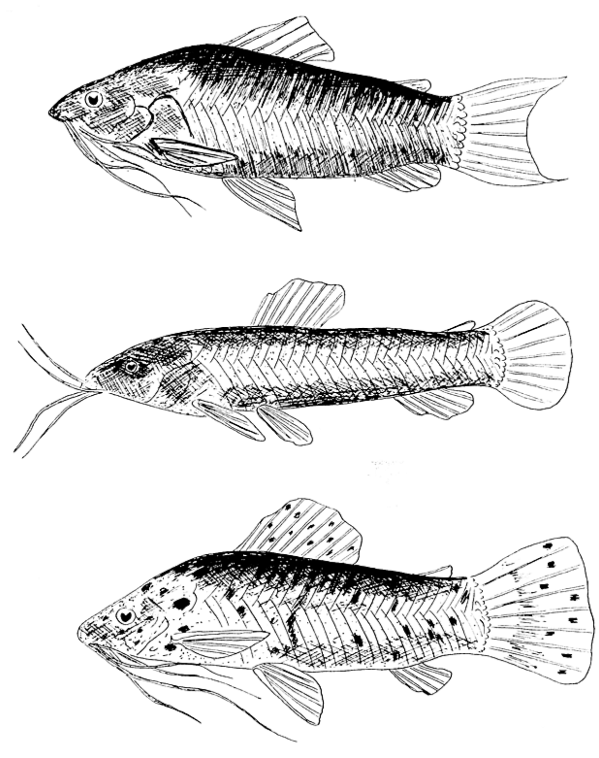
[Tropicals Magazine, Winter Issue 1961]

The family of South American catfishes, known to ichthyologists as the *Callichthyidae,* contains many well-known aquarium species (this is especially true for the subfamily, *Corydoradinae,* which includes the comical catfish genus, *Corydoras).* An interesting subfamily, at least as far as the breeding patterns of its members are concerned, is the *Callichthyinae.* The important aquarium genera in this subfamily are *Callichthys* and *Hoplosternum,* species of which are frequently seen as isolated specimens or small groups in dealers' tanks.

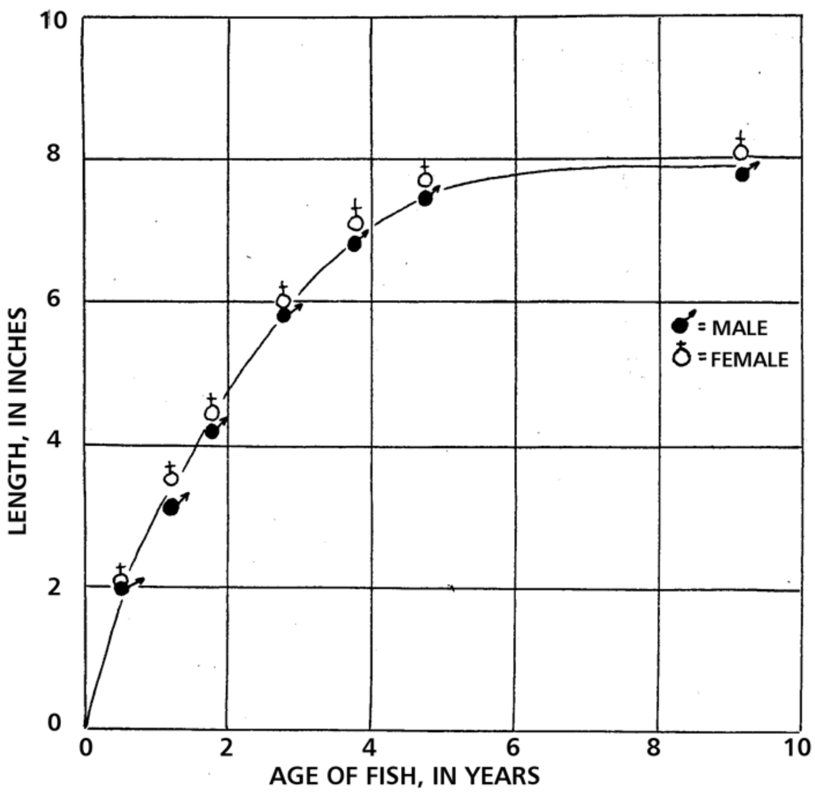
In 1829, at a time when ichthyologists knew little about parental care among fishes (a time also which boasted no aquarium fish hobby as such), the zoologist, Hancock, described the nest building and nest guarding of *Hoplosternum littorale**. At first, there was a bit of skepticism about his account but these observations were subsequently confirmed in 1886. Today, although some aquarists are familiar with the parental care afforded by the members of this subfamily, the aquarium literature is still a bit sketchy on this subject.

Aquarists do not breed members of the *Callichthyinae* very often and thus, detailed studies of their breeding habits are lacking. In general, their life habits are also somewhat ob-

*** As Dr. Hoedeman points out, nest building is an archaic way to take care of the young. Recall the fishes that build nests; *Protopteridae* (sailfins), *Mormyridae* (elephant fishes), *Gasterosteidae* (sticklebacks), *Ophiocephalidae* (snakeheads) and others.**



FROM TOP TO BOTTOM:
Hoplosternum littorale
Callichthys callichthys
Hoplosternum thoracatum



Nine-Year Growth History of *Callichthys callichthys*.

Such pairing activity continues over a considerable span of time, sometimes days. During this time, the nest is repaired and guarded. In *Hoplosternum* species (at least for *Hoplosternum littorale),* the male only guards the nest, while both male and female have been observed at this function in the case of *Callichthys callichthys. Perhaps* 500 or more eggs will be laid in clusters of from 10 to 30. It is interesting to note that, unlike the polygamous *Corydoras,* members of the *Callichthyinae* are strictly monogamous, this, of course, applying to a specific spawning cycle. In other words, many females (if available) take part in a spawning of *Corydoras* while only one female participates in a spawning of *Callichthys* or *Hoplosternum.*

scure. We know, of course, that they are not as active as the *Corydoras* - species of *Callichthys* and *Hoplosternum* are quite apt to be found, "sitting on a log," doing very little. In breeding time, however, the picture changes. The male is the one who constructs the nest (this is usually true with all nest builders) and at breeding time, the tank vegetation is clearly in danger as the male expertly clips bits from leaves with the use of his pectoral spines and girdle bones. The nest particles are tied together with mucous foam from the mouth, and expanded with air bubbles. Large specimens may produce nests of about 8" in diameter and 4" high! Upon completion of the nest, the female enters the picture. Milt is deposited in the nest and the female is induced to lay her eggs. As with the *Corydoras,* the eggs are expelled into the folded ventral fins of the female before they are placed into the nest.

As in the case of the cichlids, spawning activities may be repeated in a week and the complete spawning process extended over a period of a month or more. These subsequent spawnings are smaller than the first, numbering up to about 200 eggs. As a result, fry hatch out at intervals (the hatching time from spawning is from 5 to 8 days) and it is difficult to date any particular young fish. This accounts for the seeming discrepancy in size among the fry … actually there is little difference among fry of the same clutch of eggs.

After hatching, the fry do not immediately drop to the bottom of the aquarium but are kept in the shelter of the nest for some time. When about 14 to 16 days old, they fall or dive to the bottom to the protection of the aquarium mulm. As with kuhli loaches, these fry are sel-

FISH	DIAMETER OF EYE, (% OF THE HEAD	ORDER
Callichthys	10	Siluriformes
Ictalurus	16	Siluriformes
Clupea	28	Clupeiformes
Esox (pike)	28	Clupeiformes
Lenciscus	30	Cyprinoformes
Aphyocharax (Bloodfin)	32	Cyprinoformes
Cyprinodon	48|	Cyprinodontoformes
Fundulus	35	Cyprinodontoformes
Lepistosteus (garfish)	26	Lepistosteiformes

dom seen although they certainly are free-swimming. Like their parents, their activity is nocturnal to a great extent. If kept under good aquarium conditions, the growth rate of *Callichthys* and *Hoplosternum* past the one-year mark is steady and fairly close to linear up to a size of about 8 inches (see figure).

The larval development of these fishes is rather interesting and they have been studied in detail by Dr. Hoedeman. A time schedule appears as follows for an experiment with *Callichthys callichthys:*

The relative diameter of the eyes of just-hatched fishes is relatively small. By the way of comparison:

The tendency to spawn is influenced in nature by rainfall, shortly after the end of the dry season. As I have stressed many times in the past, there are a number of factors that are associated with precipitation: lower temperatures, increasing pH, greater oxygen content, and others. In the aquarium, spawning may be induced by artificial rainfall, i.e., using a sprinkling can or vigorous aeration.

Indicative Formation	Time after fertilization, in hours or days	Total length, mm
1st and 2nd cleavages	0- 1 hours	—
3rd cleavage and rapid subsequent segmentation	5- 8 hours	—
Large yolk with oil drops	10-16 hours	—
Embryo 1/3 circumference of egg, nerve cord	2 days	—
Oral cavity, pectorals	4- 5 days	3.5
Whiskers, barbels	4- 6 days	3.7
Tail free, long barbels,		
hatching time	5-10 days	4.0
	Time after hatching, days	
Traces of rays in pectorals	5- 7	6- 7
Free swimming larvae	26-30	20-23
First traces of skin foldings	60	30

In their natural habitat, the rainy season is approximately from the middle of November to the first half of February, and from the middle of March to the middle of August. Dr. Hoedeman found that at the end of February numerous nests were floating on the waters of the marshy areas in Dutch Guiana (to which these fishes are native). Most of these nests were abandoned but a few contained eggs and fry, and were guarded by the parent fishes *(Callichthys callichthys,* in this case). In December of the same year, he found great numbers of nests in areas not previously observed to contain them, shortly after the rains had set in. Thus, it appears that the natural breeding season is during December and January.

There are still many things about the spawning behavior of the *Callichthyinae* that are yet to be discovered by the discerning aquarist. Not enough is known about conditioning or the factors that affect the willingness to spawn. Only a few chapters in the life of these fishes have been written and it remains for thoughtful aquarists to finish the book.

What is a Species?

[Tropicals Magazine, Christmas Gift Issue 1961]

As aquarists begin to specialize in restricted groups of fishes, their attention naturally focuses upon facets of the hobby which formerly were considered "too technical" to be considered. The rising popularity of the guppy, for example, has resulted in a surge of interest in genetics, including the inheritance of characters and as "thorny" a subject as sex-linked genes. Now admittedly, this field is technical but in spite of this, many hobbyists have seen fit to learn something about it with, we hope, benefit not only to them but also to the aquarium hobby.

In a number of specialized fields of which the most prominent concerns killifishes, hobbyists have recently been involved with the question of what constitutes a species. In killifishes, the question arises because of the relatively large number of fishes involved, the tendency to run to subspecies, and the great variability in form and color of a number of important fishes in the group. It is pardonable then, if I choose to illustrate many main points of this article with examples drawn from this interesting family of fishes.

One of the major problems in taxonomy (the science of classification) has long been a satisfactory definition of the species category. The modern concept of a species is a genetical one, encompassing evolutionary roles. This was not always the case, however. The belief in fixed and sharply distinct species was widespread before Darwin, although the ancients considered species to be fluid and not sharply delimited (thus, their belief in "crosses" such as that between man and goat). The most widely quoted definition of the term "species" is that given by Mayr: "Species are groups of actually or potentially interbreeding natural populations, which are isolated reproductively from other groups." This definition requires considerable clarification.

The definition is built upon one criterion, that of interbreeding, and therein lies the difficulty. Taxonomists in general hold that condition to be necessary but not sufficient, i.e., populations that cannot produce fertile hybrids are specifically distinct (i.e., different species) whereas populations that do produce fertile hybrids are not ipso facto the same species. Thus, species of *Mollienesia* may be crossed to produce fertile hybrids, yet they are not the same species by any means. Furthermore, the interbreeding condition applies only to interbreeding in nature, and *not* those artificially induced. However, laboratory (and aquarium) experiments in crossbreeding certainly are factors in evaluating the genetical dependence between populations.

Taxonomists have long since recognized that some species are highly variable and that geographically within the area covered by these species, clearly defined subgroups could be recognized. These are called "subspecies" and by adding a subspecific term to the name of the animal concerned, a trinominal system of nomenclature results (e.g., *Aphyosemion bivittatum bivittatum* and *Aphyosemion bivittatum hollyi).* Mayr's definition is: "Subspecies are defined as geographically defined aggregates of local populations which differ taxonomically from other such subdivisions of a species." Note that these subgroups are distinguished *geographically* and not as individual freaks or artificial variants. The term "variety" has no taxonomic status whatsoever (in animal classification, that is, the situation in Botany is different) and the lowest official taxon is that of the subspecies. There are lower taxa which are useful in certain kinds of taxonomic work, e.g., "deme", a group of individual animals so localized that they are in frequent contact with each other. An example would be the ants in an individual anthill.

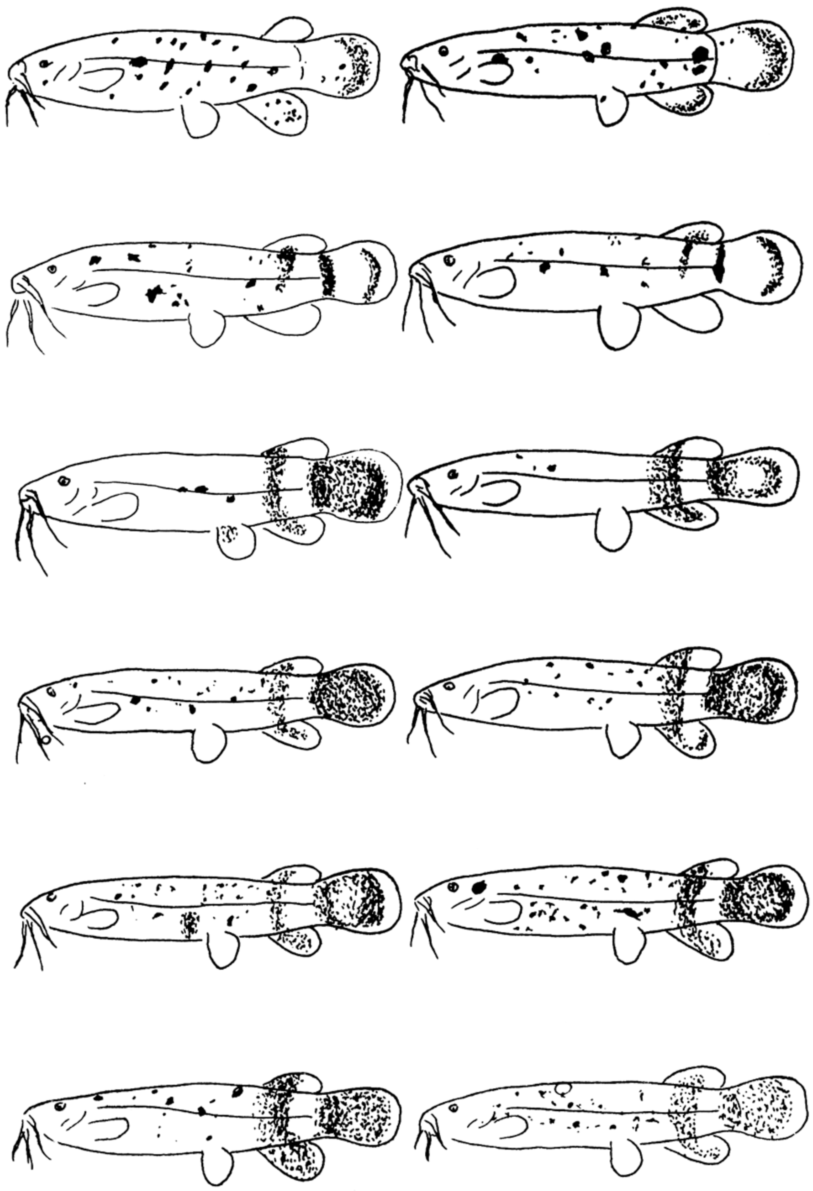


Figure 1: Variations in color patterns of the electric catfish, Malapterurus electricus (after Fowler).

Before anyone enters the species-subspecies quandary, one should ask two things: (1) Does a clear-cut objective basis for differentiating subspecies exist? (2) Is there some purpose, taxonomically speaking, served by the recognition of such infraspecific taxa? Our first question is more complicated. The latter is answered "yes" or "no" depending upon the degree of interest and specialization involved. For example, figure 1 shows variations in pattern of the electric catfish *(Malapterurus electricus)* as found in nature. Whether or not a case can be made for subspecies (question #1, in other words), aquarists would certainly be disinterested in the results since electric catfish are rare, expensive, and not bred in captivity. The region of interest in these animals as aquarium fishes is limited. The case for killifishes, however, is quite different. There, variations in form, color, and pattern assume far greater importance to aquarists.

To return to our first question, it must be realized that aquarium bred variations are just as possible among killies as they are with guppies. Two killies in particular have been selectively bred by aquarists over the years, viz., *Aphyosemion australe* and *Aphyosemion bivittatum.* Most avid killifish fanciers have their own strain of lyretail. These fish are, on the average, remarkably large and possess very elongated finnage. In addition, colors are more pronounced, especially the white markings found on the fins in this species. When fishes like these find their way to market (and they frequently do), aquarists sometimes ask, "Are these new subspecies?" Consider the case of the "golden" or "orange lyretail," for example. It has been proposed by some that this is a good subspecies, viz., *Aphyosemion australe hjerreseni.* Yet, I have never seen any valid accounts of the geographical distribution of this "subspecies" vis-à-vis what would have to be called, *Aphyosemion australe australe.* Some aquarists maintain that it is merely a xanthic aquarium bred variation of the ordinary lyretail, somewhat reminiscent of the red and yellow versions of *Rivulus urophthalinus.* But unlike in the latter species, there are a number of differences in form between the golden and the normal lyretails. Since our definition of subspecies depends upon geographical locations, however, the case is not solved yet.

In order not to completely beg all of the questions posed, I should like to suggest the approach taken by Dr. Carter Gilbert in a recent paper (COPEIA, 1961, No. 2) on hybridization

CRITERION	HYBRIDS	INTERGRADES
1. Appearance of offspring	Usually intermediate	Of average intermediacy; characteristically forming a graded series between parental forms
2. Degree of fertility	Often partially or completely sterile in at least one sex	Both sexes completely fertile
3. Sex ratio	Often abnormal	Normal, i.e., typical of parental stock
4. Heterotic effects, i.e., increased vigor or capacity for growth displayed by offspring	Often present	Absent
5. Ecological preferences of parents	Usually different	Usually similar or close
6. Breeding behavior of parents	Usually different	Usually similar

and intergradation. Dr. Gilbert classifies hybrids, a term which he restricts to offspring between two different species, and intergrades, a term restricted to offspring between two subspecies of the same genus, per criteria in the accompanying chart.

Dr. Gilbert also lists five more criteria such as frequency of crosses among natural populations containing both parental forms, but these would be difficult for aquarists to apply and will not be discussed further. I would suggest that aquarists use the words "hybrid" and "intergrade" for specific and subspecific crosses, respectively and furthermore, apply his six criteria in the determination of species and subspecies. Such a practice would provide a common basis for all aquarists to discuss such problems.

In an exchange of correspondence with Dr. Thomas Cahalan of Jefferson Valley, N. Y., we talked about whether or not *Aplocheilus dayi* and *Aplocheilus lineatus* were not really subspecies of the latter. Although I took the affirmative view (as have a number of ichthyologists), Dr. Cahalan disagreed. He observed, based upon a wealth of experience with these two "species," that the intergrade (or hybrid if you will so have it) produced is not as fertile with one another as are the parents. This would appear to violate Dr. Gilbert's 2nd criterion; however, there are not only exceptions and limitations, but the other criteria must be considered as well. Ceylon *(Aplocheilus dayi)* and India *(Aplocheilus lineatus)* are geographically separate and these two forms of *lineatus* have had a good while to approach their own genetic equilibrium. For an aquarist to, as it were, take random samples from each population consisting of two differently balanced complexes, and expect the resultant offspring to put up as good a performance as either of the parent forms, is not to be expected. Here, the evidence is admittedly overwhelmingly morphological, although the genetic evidence of visual crosses is not all negative by any means.

Dr. Cahalan, displaying true appreciation of the complexities involved, has also suggested an "order of fertility" based upon apparently similar phenotypic characteristics (characteristics which are a result of the interaction between hereditary characteristics and environment) among a series of fishes; for example, *Epiplatys sexfasciatus, Epiplatys dageti, Epiplatys chaperi,* etc. This is, of course, nothing more than the "race circle" (Rassenkreis) of German taxonomists. A Rassenkreis is a genetical species with a series of integrading but distinguishing local populations, occasionally so different that two terminal populations cannot interbreed directly even though still exchanging genes through intermediate populations. As a possible example of a race circle, I should like to offer the bivit-

		FINRAYS		
SPECIES	**LENGTH**	**DORSAL**	**ANAL**	**SCALE COUNT**
Aphyosemion bivittatum bivittatum	**65 mm**	**11-13**	**13-14**	**26-29**
Aphyosemion bivittatum hollyi	**65 mm**	**12**	**14**	**28-29**
Aphyosemion bivittatum splendopleuris	**55 mm**	**11**	**13**	**26-27**
Aphyosemion bivittatum loennbergii	**50 mm**	**11-12**	**12-13**	**26-28**
Aphyosemion bivittatum multicolor	**60 mm**	**10**	**13**	**26**

tatum complex of fishes. Morphologically, the fishes are close, forming a graded series as above.

All of these fishes inhabit the same general area in nature. Perhaps *Aphyosemion bitaeniatum* should be added to this list, but little is really known about this fish at the present. At least one fertile intergrade is known *(loennbergii vs. multicolor)* and they all share the distinctive "bivittatum pattern." I heartily agree with Dr. Cahalan that race circles exist within our hobby.

In summary then, it would appear that a species is not, and never will be, a fixed immutable unit. Unfortunately, the most widely applied definition for a species appears to be the one given by Dr. C. Tate Regan in 1925: "A species is a community or a number of related communities, whose distinctive morphological characters are, in the opinion of a competent systematist, sufficiently definite to entitle it, or them, to a specific name." It remains for aquarists to influence those ichthyologists who adhere to this definition of species, with data involving the very genetic bases of their fishes, that of hybridization, intergradation, and fertility. In this, killifish fanciers are especially fortunate for it is quite easy to include detailed studies of the embryology and development of the eggs of species in question.

Editor's note: Albert J. Klee continually amazes us with his thorough grasp of all facets of this hobby and by his skillful presentation of same. Nothing Al has written to date, in our opinion, displays his vast knowledge of this hobby better than this article, in which he does an outstanding job of making a complex subject (What is a Species?) understandable to us. We're sure our serious aquarist readers will find this article a "goldmine."

The Fin-Eating Fishes of Africa

[Tropicals Magazine, March-April 1962]

That some aquarium fishes have truly peculiar or bizarre characteristics has never failed to amaze me, and the subject of this month's article is no exception. But before we go any further, I must apologize for introducing some long, complicated, and even unpronounceable ichthyological nomenclature. It is true that, as a great memory does not make a mind, any more than a dictionary is a piece of literature, nomenclature doesn't make an aquarist. However, one can sometimes tell quite a. bit about a fish just by knowing some-thing about its "relatives," even as this is true with people at times! Therefore, we gain in the long run by attempting to fix our fishes in the general scheme of things.

Most aquarists are familiar with the family Characidae, the family to which the tetras (and many other aquarium fishes) belong. At one time, there existed a subfamily within the Characidae called Citharininae, but nowadays, this subfamily is usually given full family status by ichthyologists (there is, to be fair about it, some controversy over this among ichthyologists, however) and is now called, Citharinidae. The differences between the characids and the citharinids are mainly in dentition. something that is normally of little interest to aquarists. However, this article forms an exception. The family, which is entirely African in distribution, is split into three subfamilies: Ichthyoborinae, Distichodontinae and Citharininae, of which the middle one, Distichodontinae, provides aquarists with fishes of the g e n e r a *Nannaethiops, Neolebias, Nannocharax* and *Distichodus.* These aquarium fishes comprise a goodly number of our so-called, "African tets."

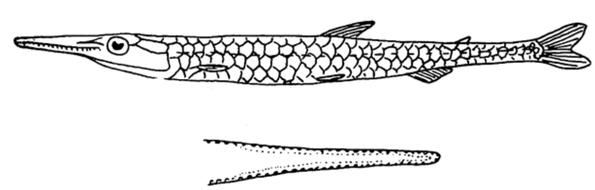


FIGURE 1: *Belonophagus tinanti.* Below is upper jaw showing dentition.

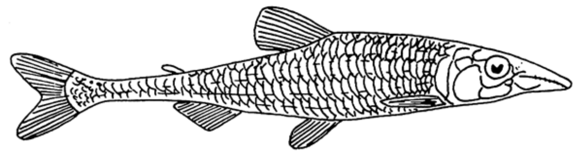


FIGURE 2: *Phago intermedius.*

Our interest, however, is with the first subfamily, the Ichthyoborinae, a strange and bizarre group of fishes. Now these fishes are not entirely unknown to the aquarium world, although they are rare. German aquarium handbooks list both *Phago loricatus* and *Phago maculatus,* and I myself have kept the latter. In addition, *Belonophago hutsebauti, Belonophagus tinanti,* and *Phago intermedius* have also been kept in the home aquarium. And what is our interest in these fishes? The surprising answer is that species of *Phago, Belonophagus,* and *Eugnathichthys* (together forming part, but not all, of the subfamily, Ichthyoborinae) have an extremely specialized and curious feeding habit, being fin eaters!

For years, men had noticed that most fishes in the Central Congo Rivers had torn and mutilated fins. At first, this condition was attributed to attacks perhaps by carnivorous species of leech, insect or fish but mostly it was thought to be the work of bacteria or some kind of fin rot. Some ichthyologists even ascribed the damage to a large predatory beetle found in the Congo that was known to attack small fishes. Then, biologists examined the gut contents of species of the genera of Ichthyoborinae mentioned and found almost nothing but fin fragments in their stomachs. It was soon concluded that these fishes are fin-eaters exclusively. When one examines these fishes, it is soon learned that all are very elongate species with powerful teeth. *Phago* and *Belonophago* are long, slender fishes with very hard, ridged scales. Their jaws too, are long and narrow (see figures 1 and *2). Eugnathichthys,* on the other hand, has somewhat broader jaws (figure 3).

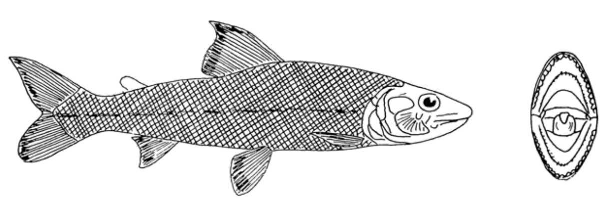


FIGURE 3: *Eugnatichthys eetveldii.*
Frontal view of mouth at right.

The teeth of these fishes are usually bicuspid and found in two parallel rows, the ones in the outer row being larger, strong, and sharp. In some respects, the dentition of these fishes resembles that of the South American piranhas. Their intestines are very short and straight. One might expect that it would take a long time to digest material as bony as fins (but apparently this is not the case.

Observations on an aquarium specimen of *Belonophagus hutsebauti* have shed light on just how the fin eating is accomplished. The fish hovered motionless (except for the vibration of the pectorals and other fins), concealed just below the surface of the aquarium in some floating plants. As soon as another fish swam by, it darted out, grabbed hold of a fin between its long jaws, and snipped off a part with a quick twist. The surprised victim also twisted and pulled away, thus aiding in the process. otherwise, the victim swam away “unharmed” but minus a piece of fin.

In addition to the genera mentioned, it is suspected that *Gavialcharax, Paraphago,* and *Phagoborus* are also fin-eaters (see figures 4, 5 and 6). In fact, the last-named is definitely known to eat fins occasionally. These fishes often are found in small groups in lakes and large rivers, close to the shore and lurking in the calm, heavily planted areas. As one might expect, the species attacked in nature are the relatively slow-moving ones such as *Disticho-*

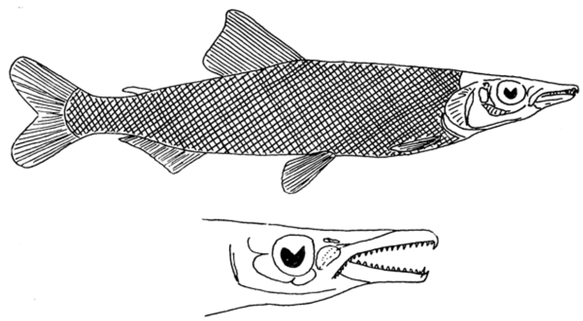


FIGURE 4: *Phagoborus ornatus.*
Mouth details below.

dus and *Tylochromis* (an odd-looking cichlid) or bottom feeders such as *Chrysichthys* (a catfish). However, even fast swimmers get "clipped" occasionally and species of *Alestes* often show lacerated fins. Commonly, the dorsal, anal, and tailfins are the ones bitten off. Although the victims are not eaten and subsequently escape, the wounds that are inflicted upon them pave the way for later bacterial and fungal at-tacks. Then too, a fish minus fins is a sitting duck for other predators. Since fin-eating fishes are common in many areas of the Congo, they are an economic nuisance in Africa. Native fishermen report that they sometimes attack even man, so they are a nuisance all the way round!

Species of *Phago* and *Belonophagus* generally do not exceed a length of from 4 to 5 inches when adult and so occasionally turn up in dealers' tanks. However, the fierce-looking nature of the critters automatically warns the aquarist not to mix other fishes in the same aquarium,

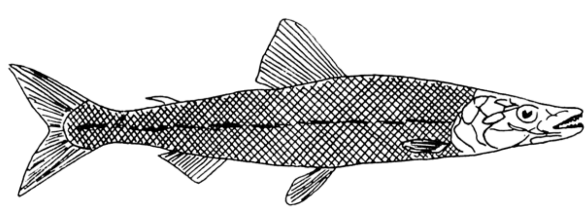


FIGURE 5: *Paraphago rostratus.*

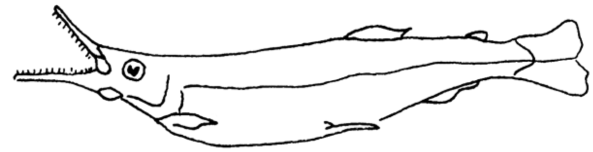


FIGURE 6: *Gavialocharax monodi.*

so the fin-eating proclivity is not well known. The German reference books, including even Sterba's fine text (*Süsswasserfische aus alter Welt*), do not mention this fact at all. In the aquarium, they are slow-moving and stick to the vicinity of plants - waiting, as it seems, for victims to swim by. The young of these species feed mostly on aquatic insect larvae in nature, but will take meaty foods such as brine shrimp in the aquarium. Adults, however, will only feed on live fishes. Since one can hardly sup-ply them with their natural food, they usually do not last long around the aquarium. Both species of *Phago* imported are not uninteresting in pattern but in color, and are mostly reddish or yellowish-brown with darker markings.

There are other fishes that feed on fins. For example, the ferocious Nyassa cichlid, *Docimodus johnstoni, is* suspected to be preponderantly a fin eater, and a number of saltwater fishes *(Runula* and *Aspidontus)* bite off the fins of other fishes.

An allied habit is that of scale eating and this is practiced by certain African cichlids, notably *Plecodus, Corematodus,* and *Genyochromis. Roeboides occidentalis,* a characin from Panama, is known to eat fish scales. In an aquarium, *Plecodus stra*eleni has been observed to feed on the scales of *Lamprologus compressiceps,* a difficult process to watch considering the high cost of *compressiceps* to the aquarist! The teeth of *Plecodus* (see figure 7) are adapted especially for de-scaling. It has been postulated that the scale-eating fishes have evolved from those fishes that graze on

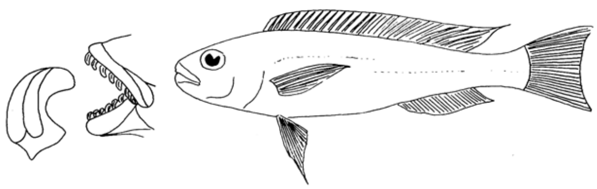


FIGURE 7: *Plecodus paradoxus.* Detail of mouth at left, together with a tooth.

algae-covered rocks, but they do not represent any close-knit group such as we find with the fin eaters.

The moral of this story is that aquarists who are plagued with the relatively minor problem of fin nipping are infinitely better off than their unwitting friends who include in their community tanks, "those interesting little fishes with the long mouths." Fin nipping is one thing, fin eating is another!

A Case of Convergence

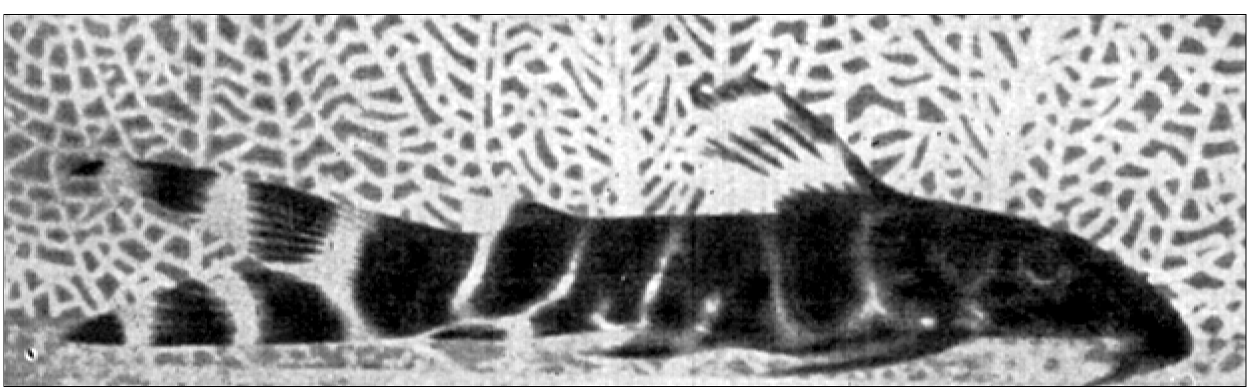
[Tropicals Magazine, May-June 1962]

Not too long ago, I received a letter from my friend, Lyle W. Hayter of Montreal, Canada, from which I should like to quote in part (with his permission):

"While on the subject of *Loricaria,* what do you think of the following? My wife and I spent our vacation at Cape May and on the way back home we stopped off at a fish shop. We spent an hour there and upon examining the large show tank, which was a central feature of the shop, I noticed several *Loricaria* on the bottom. They seemed large (a good five inches) but had a strange barred coloration of grey against a darker, brownish-black background. I commented on these fish to the attendant who said, "Yes, we thought they were odd for *Loricaria*, particularly as they reached us in an African shipment." Could there be such a fish indigenous to Africa or are people (fanciers) liberating fish in the tropics which come from other tropical waters and which are taking hold and reproducing? I suppose that the numerous East Indian and Chinese breeders must by now be cultivating angelfish in outdoor ponds which flood over now and then, carrying young fish down to streams and rivers, but *Loricaria* in Africa! ! ! Ch-e-e-e!"

Both Lyle and I are what might be called, "siluridophiles" ("catfish lovers"!), and so anything remotely connected with *Loricaria* would be likely to gain our immediate attention. In this instance, I happened to have a nodding acquaintance with the fish in question and, in fact, had on hand a lone specimen (see photograph) of a fish related to our questionable *"Loricaria."*

What the situation seemed to be, it was not. There are not only no fishes related (closely that is, for let's face it, catfishes are widely distributed throughout the world) to *Loricaria* to be found in Africa, but the possibility of "transplantations" on such a scale is out also. The answer? 'Convergence!



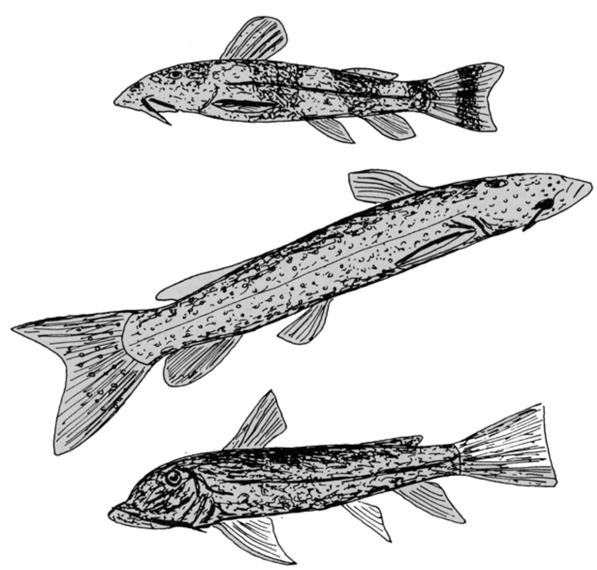
Chiloglanis **species. Photo by Albert J. Klee**

Technically, convergence is the development of similar characters separately among two or more lineages of fishes, without a common ancestry pertinent to the similarity but involving adaptation to similar ecological status. This is a bit of a mouthful as far as definitions go but it is really quite simple. For example, fishes such as *Loricaria* and *Plecostomus* are well known to aquarists as being longish, flattened catfishes with sucker mouths. Nature hews these creatures to suit its mold of environment and they are well suited to grazing on vegetable matter in moving waters. But a similar environment also exists in Africa, and a number of catfishes found there are, superficially at least, quite like these South American catfishes. Chief among the African *Loricaria*-like fishes are *Phractura, Trachyglanis* and *Belonoglanis;* among the Plecostomus-like fishes we find *Chiloglanis, Euchilichthys* and *Atopochilus* (see sketches).

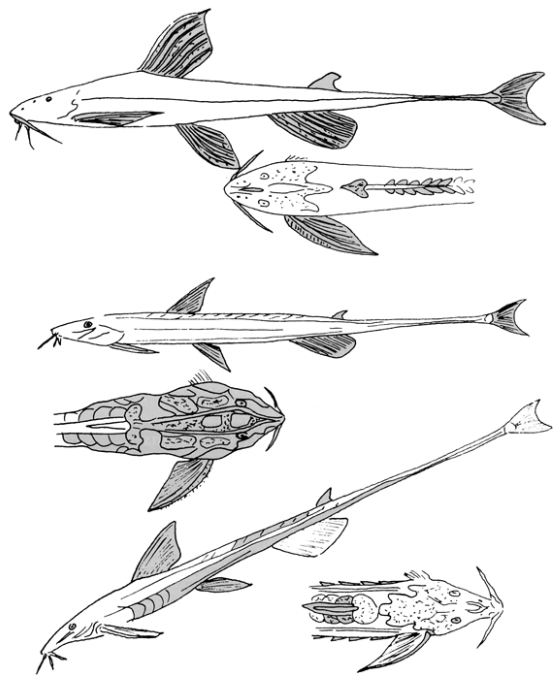
These fishes are not anywhere near as well known as their South American "counterparts" (I use this term merely with reference to the external physical resemblances) because African fishes are, on the whole, rarer in American aquaria. The point is, however, that although these African fishes resemble the South American ones, they are not closely related, ichthyologically speaking. The African genera mentioned are in the family Synodontidae while the South American genera belong to the family, Loricariidae. There are subtle differences between these two families that are hardly likely to be noticed by aquarists (such as the presence or absence of dermal teeth and the type of cells found in the epidermis). Other examples of convergence to Loricarid fishes can be found, however. For example, the members of the family, Homalopteridae (fishes related to the barbs and loaches), much resemble *Plecostomus* and its allies.

For the aquarist, convergence is a bit of a timesaver since it is a result of adaptation to environment and the aquarist's job is to provide his charges with a suitable and acceptable environment. If lie knows what environment to provide for one fish, he automatically knows it for convergent fishes. In other words, what will suffice for *Loricaria* will, in general, suffice for *Phractura.*

For the ichthyologist engaged in the classification of fishes, however, convergence can be a headache. It poses quite a problem to sort out which features are due to true phylogenetic relationships and which are due merely to adaptation to a similar environment. Thus, the pattern on the tail fins of members of the genus *Rivulus* become of some importance in identification of these fishes, while it is almost useless in the case of *Aphyosemion.* The presence of barbels, for example, is related to environment and way of life since these are functional appendages, and many fishes of diverse ancestry have them. Within *Barbus,* for instance, some species are found with four, two or no barbels. To jump to the conclusion, as some have done, that this automatically indicates a



FROM TO BOTTOM:
Chiloglanis cameronensis,
***Euchilichthys royauxi*, and**
***Atopochilus savorgnani* (after Boulenger).**



FROM TOP TO BOTTOM
(side view and top of head):
Phractura bovei,
***Trachyglanis minutus*, and**
***Belonoglanis tenuis* (after Boulenger).**

phylogenetic relationship, ignores this important principle. I can give at least one example where the existence of convergence has confused a classification picture. For many years, the bubblenest builders (Anabantids and related) were combined with the snakeheads (Channids) into one order. Today, they are generally placed into two separate orders for their similarities are now recognized for what they really are … a matter of convergence. Both groups have adapted to identical environments, environments characterized by waters deficient in the oxygen - so necessary to support life.

When we consider the word "convergence," the closely related word, "divergence," also is brought to mind. In fishes, we have divergence also. This comes about with the struggle for existence with the biological environment, the resultant geometric rate of increase of the species tending to produce divergence in habit and form. Thus, those characters are preserved which give the species a personal advantage over others provided, of course, that the divergent characters are transmissible. For example, in South America we find many different species of characins in every shape and form imaginable. If these characins had not "diverged," so to speak, they would compete with each other and ultimately only the "most adapted" would survive. Actually, however, divergence has adapted these characins to deal with different food circumstances and predator situations and therefore, all survive. This explanation of divergence is presented as a crisp contrast to the concept of convergence. The former is pressured by a struggle with the biological environment, the latter with the physical environment. Once again, we marvel at the subtle techniques with which Nature weaves its threads of life.

An innovation for killifish fanciers - The Circular Spawning Mop

[Tropicals Magazine, July-August 1962]

Since the development of the nylon spawning mop by Jacob Scheidnass in the early half of the 1950's, killifish fanciers have adopted this device to the point where it must now be considered part and parcel of the specialty itself. The advantages of the nylon mop over the use of plants are many and aquarists well appreciate the leverage these mops afford when spawning the plant-breeding killifishes. Among these advantages are the facts that:

(a) Nylon is inert in water and unlike plants, neither requires light nor litters the aquarium with organic debris.
(b) Nylon mops are easily sterilized and conveniently stored, something that cannot be said for plants.
(c) Nylon mops can be handled without fear of breakage or other damage.
(d) Excess water is quickly and easily

squeezed out of nylon mops, facilitating the search for eggs.

(e) Nylon mops can be standardized in form, size and coloration, also an advantage to the eye when looking for eggs.

The standard nylon mop is constructed so that its nylon strands emanate from one area, a "knob," located at the top of the mop. These strands are freely separable only as one proceeds away from this knob - the spawning fish being restricted somewhat from laying their eggs there. Those eggs that are laid in the vicinity of the knob are rather difficult to find and, indeed, due to this kind of construction, eggs are at times difficult to find even near the bottom of the mop. For example, one investigates a particular area only to have strands from another area interfere in the search.

In most cases, such mops are suspended in the water by a floating cork that, after some time in service, absorbs water to a point where it cannot support the weight of the mop any more. Such corks must either be replaced, or dried out before reuse.

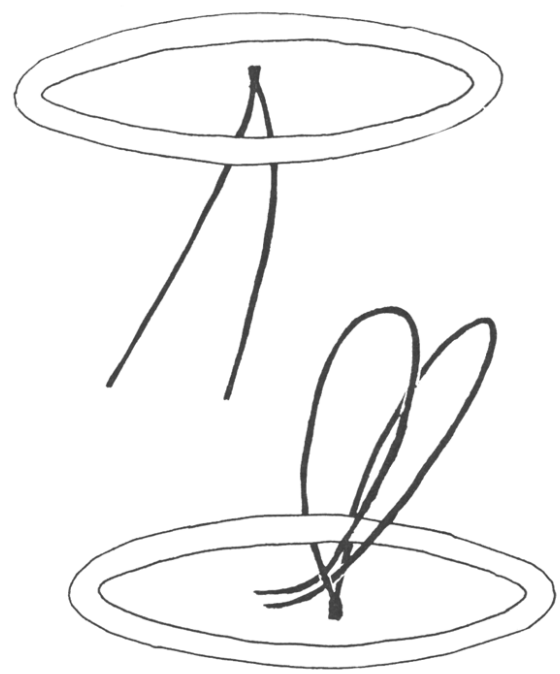
There are then, three defects in the standard mop:

1. The knob end of the mop is inefficient for catching and holding eggs.
2. There is considerable interference from neighboring strands of nylon when searching for eggs.
3. The cork quickly becomes waterlogged and as a consequence, the mop sinks to the bottom.

One answer to all of these objections lies in an entirely differently constructed mop, one that could be called the "circular mop." The first time the author saw such a mop in service was in the home of Chuck and Marge Glut of Chicago, Illinois. I was quite impressed with the design and after experimenting for over a year, have now converted entirely to this kind of mop. Many of my friends have done likewise.

The support for the circular mop is a ring, 21/2" in diameter, constructed simply of air-line tubing joined by a small piece (1/2" long) of rigid plastic tubing (the same kind the air-line tubing is usually slipped over). This replaces the cork and, of course, will never become waterlogged or sink. If, for some reason, water ever gets inside the ring, it can be pulled apart and the water blown out.

My preference is for nylon strands between 6 to 7 inches in length. Two such strands are tied together at one end, the resulting knot being trimmed closely with a pair of scissors. This knot serves to prevent slippage on the smooth tubing, insuring that the mop retains its conformation in even the most rugged of usage. The knot end is slipped up inside the ring and the two strands separated a bit to permit the two loose ends to be poked through (figure 1). The loose ends come up from the bottom around



Top - Figure 1: A tied pair of strands passed up through the inside of the ring. Bottom - Figure 2: The lower ends are passed up and around the ring, and between the open space near the knot end.

Top - Figure 3: A partially completed mop.
Bottom - Figure 4: A completed circular mop.

the ring so that when they are pulled tight, the nylon encircles the ring (figure 2 and figure **3).** By pulling it the right time and in the right place, the knot should wind up against the ring. For a neat-looking mop, I coax the knot a bit so that it lies against the underside of the ring instead of the top. Additional strands are attached in the same manner and slid over against the previously attached pair. Depending upon how tightly-pressed against one another these strands are, one can make rather loose to very compact mops (figure 4).

The construction of circular mops may sound tedious and to some extent it is. Certainly they take longer in preparation than the usual kind of mop. However, the process soon becomes routine and one's fingers acquire some nimbleness in the operation. In the course of an evening watching television, one can make perhaps three or four such mops. The time is well spent since the mops last indefinitely. Such an investment is highly recommended.

What is a Genus?

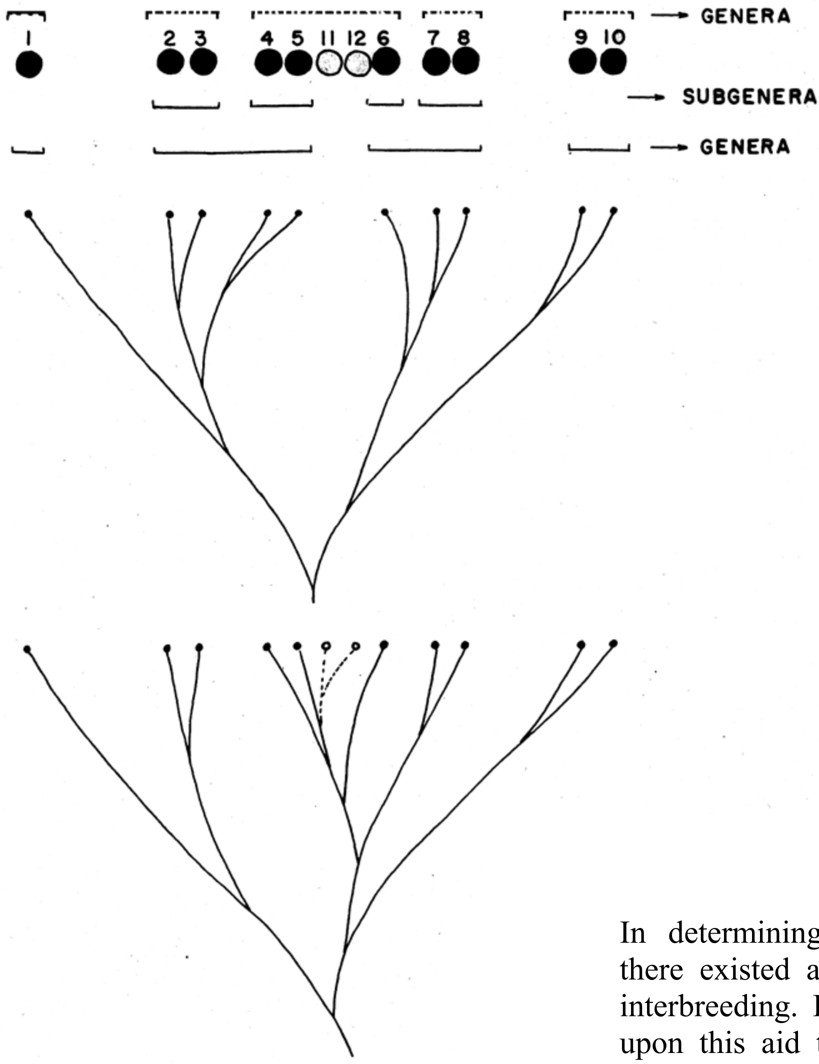
[Tropicals Magazine, Holiday Issue 1962]

A classic definition of a man is that he is a "featherless biped with nails." The possession of nails is mentioned in this definition, so it is said, to avoid confusion between men and plucked chickens. Our example merely keynotes one of the many problems in taxonomy, the science of classification.

In the previous issue, we discussed the various problems encountered in determining what constituted a species and tried to show, with respect to our hobby, where such questions are appropriate and where they are not. This article is concerned with similar questions but applied to a higher category, that of the genus. Next to the species, the genus has a special status in the aquarium world. For one thing, it frequently is a convenient unit for discussing fishes. For example, although nothing less than species will satisfy questions of individual description and identification, we use the term "rasbora" when describing where these fishes are found, how they breed and what their requirements are. Rasbora is of generic derivation (indeed it is, in its scientific sense, a valid genus of fishes) and it is a useful term in many cases where the species would be too specific and family, too broad. The cyprinids (the family containing the rasboras) include groups of rather diverse fishes, aquarium speaking, such as the barbs, rasboras, and the carps.

The aquarist's span of attention is seldom directed to more than a single genus at a time. Killifish fanciers, for instance, are interested in the whole of the family Cyprinodontidae, but they seldom think of their activities as being on this large a scale. Listen in on their conversations and they will be talking "*Nothobranchius*," "*Aphyosemion*," etc., but not the family or, for that matter, any of the currently recognized, eight subfamilies.

Why is the genus generally so appropriate a unit for hobby discussions? The higher the



I-A

I-B

I-C

LEFT - FIGURE 1

category in classification, the more likely are the units to lend themselves to more distinct characters in common. In short, they are more easily definable. Then, too, although they are scattered geographically to a greater extent than their species, their range is still conveniently localized for conversation. They frequently share the same aquarium requirements and often share the same reproductive patterns among their members. In general, if one has described one barb, one has described them all. That there are exceptions it is admitted, nevertheless, my statements are true for the vast majority of cases.

In determining what constitutes a species, there existed a convenient yardstick, that of interbreeding. For the genus, we cannot rely upon this aid to any great ex-tent for intergeneric hybrids are not as common as interspecific ones, nor are they as fertile. But if such hybrids are to be had, they certainly do bear upon the relationships between individual genera. In the absence of such information (the usual case), ichthyologists rely on morphological examination of fishes to a great extent. The experience and judgment of the ichthyologist also enters the picture and frequently, great insight must be had to formulate genera on a meaningful basis. Such conclusions must agree with all evolutionary evidence.

Suppose, for example, that our ichthyologist had examined ten species of fishes and arranged them in a horizontal scale based upon closeness of morphological characteristics (scale and fin counts, osteological examination, etc.) as in the solid circles in figure 1-A. This figure portrays these ten species as solid circles and the distance separating them represents the "closeness" of their relationships (species no. 1 is most closely related to species no. 2, and most removed from species no. 10). It would not he unreasonable to conclude that four separate groups comprised the series. Perhaps our ichthyologist would deem these to be four different genera (considering only the solid lines in figure 1-A). An even closer look may prompt him to recognize subgenera in two of them (2 plus 3 and 4 plus 5; also 6 and 7 plus 8).

Immediately below figure 1-A appears 1-B, a phylogenetic tree showing the true relationships from an evolutionary standpoint, of the ten species in solid circles. If this were the true picture, then our ichthyologist has done quite well, indeed. His "genera" and "subgenera" reflect the true picture and are not misleading.

But suppose the true phylogeny is as is shown in figure 1-C (consider only the solid lines for the moment). Then our ichthyologist is in trouble. He has confused convergence with resemblance due to inheritance from a common ancestry. In plain words, the similarity of species 2 and 3 to species 4 and 5 was only due to adaptation to a similar environment. It was not due to a common evolutionary line (not recent in time, anyway).

By now, the reader should have an appreciation for the problems inherent in the determination of all higher categories, and not just the genus itself. Let us imagine that 5 years later, two new species, 11 and 12, are discovered. The picture appears to change considerably now. Our ichthyologist re-classifies his genera and subgenera somewhat resulting in the situation shown in figure 1-A, incorporating the extra circles and using the dotted lines now. Now the classification fits the phylogeny shown in figure 1-C (all lines). The classification is again reasonable, that is, until additional information proves otherwise!

Thus the ichthyologist formulates his genera and subgenera on the basis of (1), degrees of separation (gaps), (2), amount of divergence and (3), the multiplicity of lower taxa. To illustrate the last-names briefly, suppose the original ten species had been equally spaced so far as similarity to its neighbor was concerned. Then our ichthyologist would have two choices to make: (1) devise ten separate genera or (2), place all in a single genus. The first would result in monotypic genera (i.e., genera with but a single species) as well as a heap of them! As it was, species no. 1 was placed in a genus by itself, but it seemed the logical thing to do, based on the situation as it was known in its entirety.

Where in our hobby experience have we encountered something similar to our hypothetical example? Consider, if you will, the fishes we are now lumping under the genus *Aphyosemion.* In 1933 in the course of his preliminary work with the killifishes, Dr. George Myers split up the genus into three subgenera: *Aphyosemion, Fundulopanchax* and *Callophanchax.* We will be concerned only with the first two for the moment (the last-named contains only one rather aberrant species, *Aphyosemion sjoestedti).* A typical member of the *Aphyo*semion subgenus is the lyretail, *Aphyosemion australe.* It is a small, delicate fish with a short dorsal fin, set well behind the anal fin. Furthermore, it is a typical plant spawner. A representative member of the *Fundulopanchax* subgenus is the blue gularis, *Aphyosemion gulare coeruleum.* It is a large, bulky fish with an undershot lower jaw and a long dorsal fin set right over the anal fin. It is not a plant spawner at all, but a soil breeder. If all the respective members of these two subgenera were like the two types mentioned, then the separation within the genus would be distinct and logical.

But consider now, *Aphyosemion bivittatum.* This fish has a long dorsal set over the anal fin as in the blue gularis but otherwise resembles the lyretail. It is a slim fish and a plant spawner. What to do about this fish? In which subgenus should it be placed? On the basis of morphology, it certainly should be placed in *Fundulopanchax* but this would do violence to the breeding relationships and aquarium behavior displayed, one of the bases for the recognition of the genus *Aphyosemion* in the first place. As a matter of fact, when one considers a series such as *Aphyosemion. filarnentosum, gulare gulare, bivittatum hollyi, meinkeni,* and *vexillifer,* it is difficult to formulate two subgenera on the basis of dorsal/anal juxtaposition (see figure 2). A similar confusing series can easily be found, based upon dorsal ray count only.

In a recent interesting exchange of correspondence with Dr. Myers, he has kindly permitted me to quote his following words (re *Aphyosemion): "*I can say pretty confidently that the subgenera were rather shaky even then and I seized upon anything I could to define them morphologically. Moreover, if I were redoing the classification of this group in the light of what we know today, I would not separate the subgenera *Aphyosemion* and *Fundulopanchax."*

In short then, after the preliminary spadework is completed and additional fishes are obtained, the classification picture may change perforce! That the classification may not necessarily become clearer, however, is illustrated by the fact that there exists today a controversy over certain killifishes regarding whether they should be placed in genus *Aphyosemion* or in genus *Nothobranchius. Aphyosemion walkeri is a* case in point. Like *Aphyosemion sjoestedti,* it can be considered a true "annual" (defined here as a fish laying eggs that go through a drying period in nature as a matter of course). Actually, the differences be-

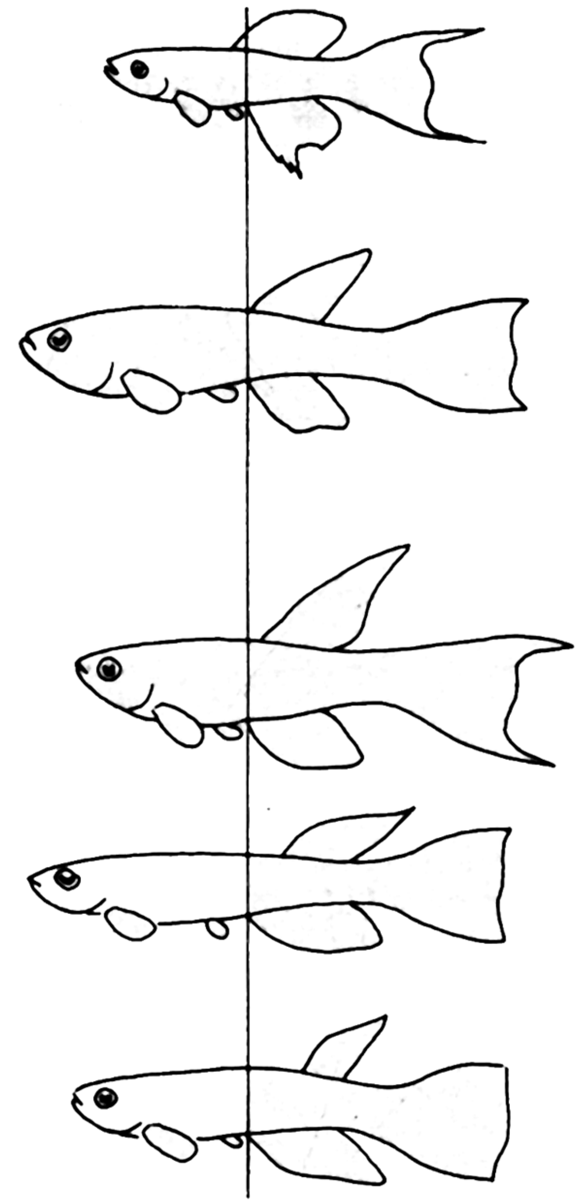


FIGURE 2: A graded series of *Aphyosemion* species with reference to dorsal/anal fin juxtaposition. From top to bottom: *filamentosum, gulare gulare, bivittatum hollyi, meinkeni* and *vexillifer.* The reader is invited to form subgenera on the basis of these juxtapositions!

tween these two genera are slight when certain "handpicked" series of species are considered. To finish Dr. Myers' quote: "Moreover, I would think a long time before I would recognize the genus *Aphyosemion* at all. It probably grades into *Nothobranchius so* gradually that the genera are not easily separable. But please note that I say `probably.' We don't know yet."

Some readers may be familiar with the terms "lumping" and "splitting." Splitters are those who prefer the narrowest standards of divergence and diversity with which to recognize taxa, and so tend to recognize maximum numbers of taxa at each level. For example, such persons might recognize three genera instead one when considering *Aphyosemion.* Lumpers, on the other hand, prefer the widest practicable standards and recognize minimum numbers of taxa (for example, such persons might lump *Aphyosemion, Nothobranchius* and even *Epiplatys* into one genus!). Dr. Simpson has given us this definition of a splitter (if I may re-phrase his statement considerably with respect to our hobby): "A splitter is one who, if able to distinguish between two fishes, will place them in separate genera but if unable to distinguish between them, will place them in two separate species!"

Like all of us, perhaps, ichthyologists also tend towards being one or the other. Within a man's specialty, there is a tendency to become a splitter because in such cases, the multiplicity of taxa reflects his minuscule knowledge about the subject and is more of a convenience than a nuisance. This same splitter, however, may "cuss out" a specialist in another field who has done the same thing and what our first friend would loudly label, "unnecessary subdivisions!"

Within the aquarium hobby, there are a number of specialties (guppies, discus, killifishes, etc.) and as might be expected, these aquarists tend to be splitters within their own specialties. To them, slight differences loom large and they are impatient when these differences are not recognized taxonomically by the ichthyologist. For example, killifish fanciers are comfortable with *Cynolebias* and *Cynopoecilus* since the use of two generic terms seems to serve notice that their respective species are different (I certainly don't disagree that important differences exist). But ichthyologists (especially those who really know these fishes) consider *Cynopoecilus* to be a sub-genus of *Cynolebias.* To those aquarists who object, I merely ask why they haven't objected long ago and insisted upon a separate genus for *Aphyosemion sjoestedti* since there are as many (or more) differences between *sjoestedti* and any of the other aphyosemions, both in breeding and in morphology, as there are between member of *Cynolebias* and *"Cynopoecilus."*

Admittedly, I am somewhat of a lumper myself but most assuredly, too many aquarists are splitters. Perhaps the guppy enthusiasts will object violently but a number of noted specialists in the family Poeciliidae have lumped *Mollienesia, Lebistes, Limia, Micropoecilia* and other genera into a single genus, *Poecilia.* Thus, the guppy now becomes *Poecilia reticulata* in the minds of those ichthyologists who have studied the classification of these fishes in their minutest detail. Since I am not what would be considered a rabid guppy fancier, I like this classification very much because it explains rather handily the "intergeneric" *Mollienesia x Lebistes* crosses that pop up occasionally. Dr. Don Rosen has stated that *Mollienesia* and *Lebistes* are separable only nominally and it would appear that genetic evidence bears him out. This is only one of the many interesting questions when one considers, "What is a genus?"

Along certain lines of endeavor, the problem of classification is being attacked via use of symbolic logic and high-speed digital computers. Basically, these approaches involve the multiple correlations of large amounts of taxonomic data. It has only been recently that ichthyologists have taken to statistical descriptions of new species based upon many specimens instead of the one or two so common in the past. The College Of Fisheries at the University of Washington has recently worked with the classification and taxonomy of *Pseudomonas* and related bacteria using an IBM 650 computer. *Pseudomonas,* some aquarists will recall, is the bacterium suspected of causing the neon tetra disease and many others. Their work indicated that the genus level (for these bacteria groups) might lie approximately at the 60% similarity value, while the species level may lie at the 75% similarity value. What this means is that organisms of the same genus will share about 60% of their characters, and species will share about 75% of their characters. It would be most interesting to see such techniques applied to fishes. I for one would suspect that the similarity value between *Aphyosemion* and *Nothobranchius* would exceed 80% but only an intensive statistical investigation into these two genera would bear me out, and I fear this may never he done.

Sexing Fishes With Pascal's Triangle

[Tropicals Magazine, January-February 1963]

Because it seems safe to assert that there will always be some readers of Tropicals who like to fiddle with numbers, we introduce a concept known as, "Pascal's Triangle." Now this is not to be interpreted that Pascal had a marital problem because above all, Pascal was a bachelor. He might have been also a great mathematician but the consensus is that he never quite made the grade. In spite of this, his Triangle definitely forms a contribution to the aquarium hobby and luckily for us, the patent on this invention ran out sometime in the late 1600's.

Pascal's Triangle is the essence of simplicity and a portion of it is presented in the sketch. Inspection will show that each term in the triangle is derived by adding together the two terms in the lines above that lie on either side of it (we cheat a bit on this definition by starting out with a sort of arrowhead of 1's). Thus, in the line for n = 7, the term 21 is found by adding together the terms 6 and 15.

I suppose a fair comment at this point would be, "So what?" Pascal has no reputation as one of the leading pioneers in our hobby so a bit of scoffing is permissible … but now, down to business.

Consider the following frequently encountered aquarium problem. An aquarist of reasonable but still bounded means is contemplating the purchase of a certain fish with a view towards ultimately spawning them. Now if the fish in question is some sort of guppy, for example, the problem of picking a pair vanishes. There comes a point at which every beginner is able to sex guppies. If the fish concerned are scats, however, young discus or baby Blue Gularis, no one laughs when you complain about the sexing problem, no matter how long you have been in the hobby. At current discus prices, a mistake in sexing can find you back at the old stand again, watching television with fish tanks rusting in the attic.

Since it sours the disposition to always take the pessimistic view of things, let's assume that the dealer's tank to be sampled contains an approximate 50-50 distribution of males and females. Over the long run and in general, this seems to be a fair enough assumption anyway and when we are uncertain, it is wise to plan on the most likely event to occur.

Now surprisingly enough, Pascal's Triangle gives us the odds for obtaining pairs from any number of fishes we may buy. This use of his device may seem like an awful degradation but as it was originally used to compute gambling odds, I don't suppose he has any kick coming. Let's agree on one thing before we start and that is, to consider that we are interested in the number of males in our sample. We could look at it from the female fish point of view but it amounts to six of one, half dozen of the other and let's face it, the males are prettier anyway.

Suppose we netted 3 fishes from the dealer's tank. There are four possible events as follows:

(a) We get 0 males.
(b) We get 1 male.
(c) We get 2 males.
(d) We get 3 males.

Now if we wind up with either (a) or (d), we are out of luck as far as obtaining a true pair goes. On the other hand, (b) gives us one pair and (c) gives us one pair. As we pull these three fish from the tank, let's enumerate the ways in which the stated four events can occur.

Event (a): There is only one way to pull out 0 males and that is to catch one female after the other!
Event (b): There are, however, *three* ways to pull out one male. He can be caught on either the 1st, 2nd or 3rd dip of the net (assuming we catch a fish every time we dip!).
Event (c): Again, *three* ways. The two males can be caught on the 1st and 2nd tries, 1st and 3rd tries, or 2nd and 3rd tries.

n	PASCAL'S TRIANGLE
1	1
2	1 2 1
3	1 3 3 1
4	1 4 6 4 1
5	1 5 10 10 5 1
6	1 6 15 20 15 6 1
7	1 7 21 35 35 21 7 1
8	1 8 28 56 70 56 28 8 1

Event (d): We dislike being repetitious but there is only one way to get 3 males and that is to catch one male after another.

When we add up all the ways in which these four events can occur, we find that they total 8 (1+3+3+1=8). The reader who is still with us will quickly discern that the 1, 3, 3, 1 form the line in Pascal's Triangle to the right of the sample number, n, of 3. Take a look at a really hard example, viz., a sample of 8. The numbers in the Triangle here are:

1, 8, 28, 56, 70, 56, 28, 8, 1

These are the number of ways one can wind up with 0, 1, 2, 3, 4, 5, 6, 7, and 8 males respectively, when you purchase 8 fish. Add up this row and you should get 256. Let's return to our simple example for the moment, the one for which n = 3.

Since there are two ways in which we can wind up with *no* pair out of a total of 8 ways, the chance of not obtaining a pair is 2/8 or 25%. Conversely, there are 6 ways in which we can wind up with one pair and the probability for this is 6/8 or 75%. Now back to our more complicated example, that for n = 8.

Note that there are 70 ways in which we can obtain exactly 4 males and since 4 males represents four pairs, the probability of obtaining exactly four pairs from a purchase of 8 fishes is 70/256 or about 27.3%. The computation for obtaining exactly three pairs is a smidgeon more complicated since we can get three pairs with either 3 males or 5 males. There are 56+56=112 ways to get this result and the probability is 112/256= 43.8%. Note, however, that these are the probabilities for obtaining *exactly* the number of pairs stated. If we merely wanted to compute the chance for obtaining at *least* two pairs, say, then any result giving us either two, three or four pairs satisfies our requirement. Now the leading 1 and 8 in Pascal's Triangle do not help us since they are the number of ways we can obtain 0 and 1 males respectively, and neither of these results gives us a minimum of two pairs. The trailing *8* and 1 are similar for they are the number of ways we can obtain 7 and *8* males respectively, and those results also do not give us a minimum of two pairs. What is left,

28 + 56 + 70 + 56 + 28 = 238

represents the ways in which we can obtain two, three or four pairs so the probability for obtaining at *least* two pairs is *238/256 = 93%,* pretty good odds at that. Note carefully that the probability of getting *exactly* two pairs is *56/256 = 21.9%.* The *56* comes from adding *28* and *28,* the ways in which we can obtain 2 males and 6 males respectively. The reader will recognize (if you have stayed awake all this while, that is!) that these two events are the only ways in which we can obtain exactly two pairs.

From here, you have carte blanche to do your own computations and, if you will, to expand Pascal's Triangle to accommodate any prospective number of fishes you might want to purchase. The probabilities are easy to compute and involve just adding some simple numbers and dividing by a grand total. In all of this bear in mind the statement of Francis Bacon: "If a man will begin with certainties he shall end in doubts; but if he will be content to begin with doubts he shall end in certainties."

Aquarium Experimentation

[Tropicals Magazine, March-April 1963]

Most of what passes as experimentation in the aquarium hobby today is nothing short of a laugh. Month in, month out, mountains of conclusions are obtained from molehills of data until we extrapolate ourselves from regions of abysmal ignorance to regions of "pro-found knowledge." The word "controlled experiment" itself has been prostituted, as have myriads of other technical and scientific terms until they no longer have much meaning in this hobby of ours. From time to time in my writings I have tried to be constructive in my criticism of this situation, and I should not like to alter this philosophy now. In this article, an attempt will be made to deal with one type of aquarium hobby situation that is of considerable importance to those wishing to forego mockery of experimental methods.

In our hobby we frequently encounter important variables that, as a practical matter, cannot be measured. Consider, for example, that an aquarist has formulated a "super drug" consisting of equal parts of acriflavine, methylene blue, malachite green and copper sulfate (incidentally, this type of ghastly combination may not be as silly as it sounds!) and he wishes to deter mine the concentration at which the combination is fatal to fishes. This is a most practical matter for if one desires a treatment for a disease, it is important to learn something about the dangers involved to the fish in using the treatment. Now surely there exists some critical concentration for the combination of drugs under consideration under a given set of conditions (such a critical concentration really being an average of some sort since living animals do not all respond in exactly the identical manner to a given set of circumstances). Nevertheless, it is impossible for us to find this critical concentration for should we try out an arbitrary dosage on a test fish that results in its death, we cannot try out a reduced dosage on the same animal. If aquarists had the facilities that some large research laboratories possess, then one could conduct experiments upon thousands of fishes, utilizing dozens of different concentrations. Aquarists rarely have access to such facilities, however. It is understandable also when one points out that the fish we are interested in might well be expensive, hard to obtain, or a combination of both.

Some of my friends, who do derive pleasure from running meaningful aquarium experiments, have asked me for a practical solution to what I call, "sensitivity investigations" (one need not be concerned with lethal dosages for the interest might be in, as examples, temperature limits for certain fishes, tolerance of fish to light, reaction of fish to selected stimuli, etc.). Herewith is a method (called the "up-and-down method"!) which is extremely simple and which conserves experimental effort. It will be explained using our "super drug" example but as we have noted, its application is not restricted to this alone.

1. Take a guess as to what you think the critical dosage (which we carefully define as that dosage at which 50% of the test fishes die … this is known as the LD 50) might be. It doesn't matter if your guess is wrong; all we need is some starting point. For our example, we choose 2 ppm.

2. At equal intervals, devise dosages above and below the guess you have just made. Let us choose for example, the following series (in ppm):

0.8, 1.1, 1.4, 17, 2.0, 2.3, 2.6, 2.9, 3.2

If we find we need additional categories, we may add them later.

3. Now test one fish at our guessed critical dosage of 2 ppm. If this fish dies within a standard period of time, test a new fish at the next lower dosage. If it lives, test a new fish (not the same one) at the next higher dosage. Continue on his plan of attack until you have used up your quota of fishes (some of which will have died and some of which will have lived). Table I shows the results of an experiment with 60 fishes. Notice that contrary to our preliminary estimates, we never needed to investigate dosages greater than 2 ppm in this example.

4. Now determine which is the less frequent event. Since out of the 60 fish, 29 lived and 31 died, the less frequent event is "lived." Our critical dosage is then computed as follows:

$$D=(A+B)(C/N \pm \tfrac{1}{2})$$

where A is the lowest level on which the less frequent event occurred (in our example, A was 0.8), B is the interval between dosages (in our example B is 0.3), and C and N are computed as follows. Arrange the totals for the less frequent event in a separate table, numbering them from bottom to top starting with zero. Then form the product of these numbers and sum to obtain N and C (see Table II).

Formula for D is somewhat indefinite (in that it contains the factor, ± ½. It is resolved as follows. We use +1/2 if our less frequent event is one that made us go up in level of dosage, and -1/2 if it made us go down. Our less fre-

TABLE I : RESULTS OF TEST
d = died, l = lived

		totals	
Dosage, ppm		**d**	**l**
2.0	**d**	**1**	**0**
1.7	**d d d d d d d d d d**	**10**	**0**
1.4	**l d l d d d d d l l d l d d d l d d d d l d d l d d d l d**	**18**	**9**
1.1	**l d l l l l l l l l l l l l l l l l d l**	**2**	**18**
0.8	**l l**	**0**	**2**

TABLE II		
NO.	TOTAL	PRODUCT
2	9	18
1	18	18
0	2	0
	N = 29	C = 36

quent event was "lived" and since this made us go up it our dosage, we use +1/2 in our formula. Our estimate of our critical dosage is then

$$D= 0.8 + .03 (36/29 + 1/2) = 1.32 \text{ ppm}$$

A few remarks may he helpful at this point. First notice that what we really have done is, in very general terms, as follows:

(a) We have designed an experimental program.
(b) We have then estimated the average critical level (i.e., the point at which 50% of our test fishes are affected and 50% are not).

The up-and-down method is applicable only when our intervals are chosen reasonably. If in our example we had chosen intervals as 0 ppm, 3 ppm, 6 ppm, etc., all of our test fishes would have lived at the 0 ppm level and all would have died at the 3 ppm level or higher. This in-formation tells us little other than the fact that 3 ppm is definitely fatal. The intervals chosen, then, should be meaningful. However, if you mis-choose your intervals, you will find it out in a short time!

One final caution. My biologist friends tell me that it is better to utilize the logarithms of the dosage concentrations and then space these evenly, rather than spacing the intervals on the dosages directly. This is because of peculiarities of the dosage-mortality relationship but should cause no difficulties since logarithms are easily available from any high school textbook. For example, the log of 2 (our guess for the critical dosage) is about 0.3 and using an interval of 0.2, our dosage levels (in logs) would be:
-0.9, 0.1, 0.3, 0.5, 0.7, representing actual dosages of about 0.1, 1.0, 2.0, 3.2 and 5.0 respectively. The critical dosage, D, will be computed as a logarithm, however, and should be converted back into a ppm figure before use.

Should any reader of Tropicals desire assistance in the designing of aquarium experiments, or the analysis of aquarium data, I would be happy to volunteer my time to the best of my ability.

Aquarium Fishes From The Mysterious Island

[Tropicals Magazine, May-June 1963]

If I choose to term Borneo as "the mysterious island," it is not only because it is a strange land in history, custom, and culture, but a strange land in its fish fauna as well. Although this alone would be reason enough to consider what Borneo has to offer in the way of aquarium fishes, there is added incentive in that we as hobbyists are just beginning to see imports in reasonable quantity from this area. Furthermore, it is really a field about which little is available in the aquarium literature.

Borneo basically is a tropical island, at one time covered by vast forests. However, a good portion of the Bornean forestland has been displaced by civilization in favor of oceans of cultivated fields. Geographically, the island runs extremes from mountains to lowlands and consequently, those expecting at least a varied fish fauna will not be disappointed. Perhaps one of the best ways to take a "Cook's tour" of its fishes would be to present contrasts between those Bornean fishes with which aquarists are already fairly familiar, and the new ones that Borneo has to offer.

A good starting place is the genus *Rasbora. Rasbora* specialists are well acquainted with three of Borneo's rasboras, viz., *R. einthoveni, R. elegans*, and *R. argyrotaenia.* One not well known, however, is *R. myersi* (figure 1). Another interesting contrast is between the familiar *Barbus binotatus* and the not-so-familiar *Barbus sealei,* the latter with a number of large, dark spots over its body and bright orange anal and tail fins (figure 2). This is just a sample, however, for Borneo has many barbs suitable for the aquarium.

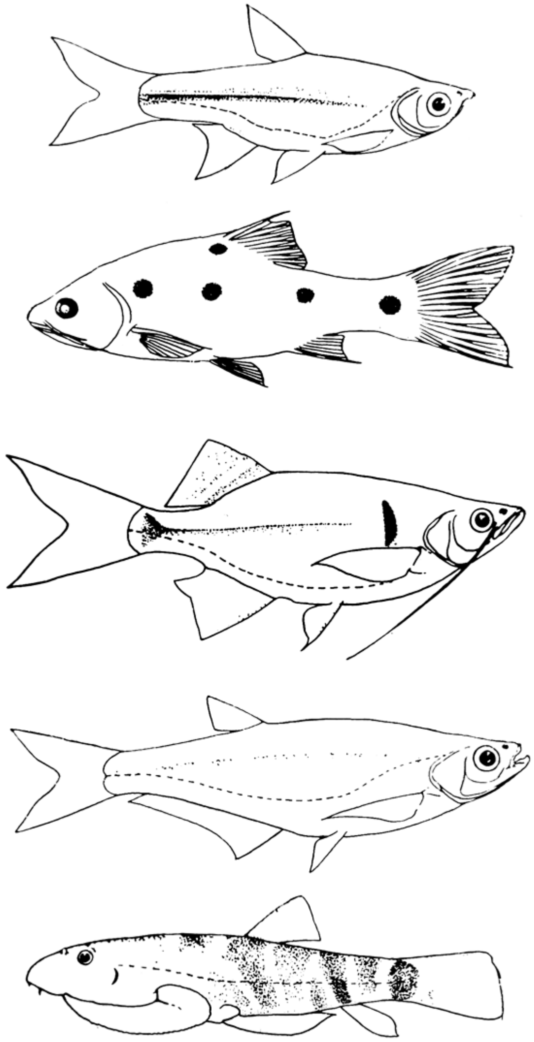
An interesting group of fishes is the so-called "flying barbs," represented by *Nematabramis everetti* and *Chela* (formerly *Oxygaster) oxygastroides* (figures 3 and 4). The latter has been imported as an aquarium fish many times. Both are lively fishes somewhat reminiscent of our South American hatchet fishes, to which they are not related, however.

One of the strangest fish families found in Borneo is the Gastromyzontidae (figure 5), a series of fishes well adapted to life in rocky torrents. Like *Loricaria,* these fishes graze on diatoms and algae. One also finds loaches in Borneo, a particularly interesting one being *Nemachilus selangoricus* (figure 6). This fish has a series of scales on its tail root, each one bearing a small spine. Aquarists are also familiar with the genus of loaches known as *Acanthophthalmus,* the genus being well represented on the island.

One of the best known of all aquarium fishes is *Betta splendens* and although this fish is not known from Borneo (North Borneo, at least), two others are; *Betta balunga* and *Betta unimaculata.* The latter species (figure 7) is more elongated than *B. splendens* and is quite common in its natural habitat. It occurs in streams that dwindle to small pools connected only by trickles of water. Other Bornean labyrinth fishes include the climbing perch *(Anabas testudineus),* the blue gourami *(Trichogaster trichopterus)* and the original "goramy" *(Osphronemus goramy)* from which we obtain the popular name. A very old aquarium fish, but rare nevertheless, is the nandid, *Nandus nebulosus* (figure 8). It is Borneo's answer to our South American leaf fish, *Monocirrhus.* Another odd fish is *Toxotes chatareus,* the existence of which may come as a surprise to those aquarists who think there is but one archerfish! Actually, there are a number of species within the genus *Toxotes* but this is the only one from Borneo.

Borneo has its full share (and maybe even more!) of gobies and its mudskipper candidate is *Periophthalmodon tredecemradiatus* (figure 9). Incidentally, the spelling of its generic name is no mistake! It is not identical with our more familiar mudskipper genus. There are a number of *Brachygobius* species from Borneo including the familiar *B. doriae* and the less-

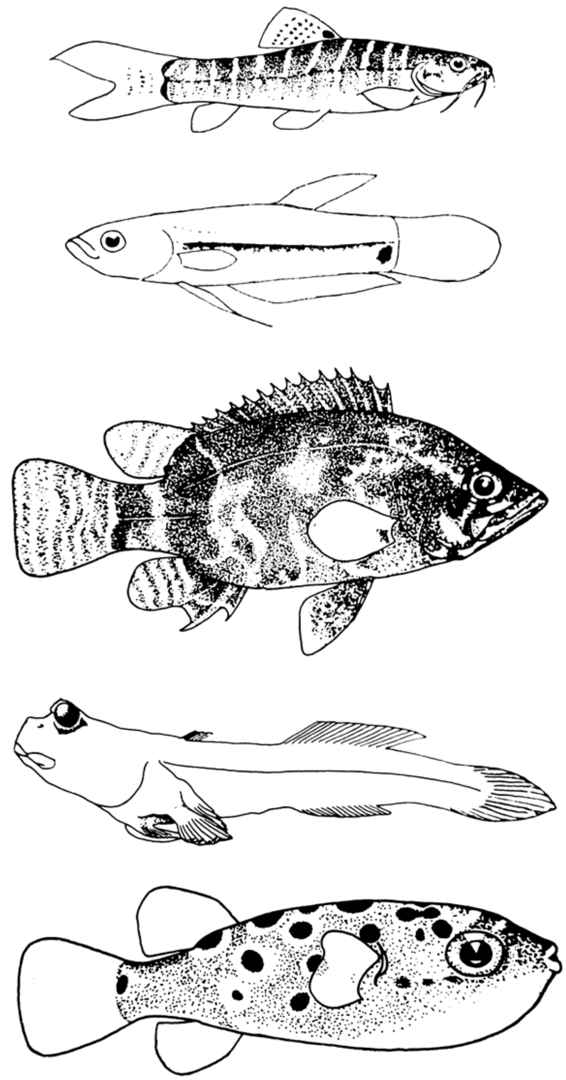
ROUGH MAP LOCATING ISLAND of BORNEO



FROM TOP TO BOTTOM:
Rasbora myersi
Barbus sealel
Nematabramis everetti
Chela oxygastroides
Gastromyzon borneensis

familiar *B. sabanus* and *B. kabiliensis.* Basically, these three fishes are very similar, sporting black bands on a yellow background. Even puffers are represented and Borneo offers *Tetraodon leiurus* (figure 10) as one example. It has numerous black spots on an olive-green background.

One is amused to find that a number of aquarium fishes are cultivated as food fishes in Borneo! These include the goldfish *(Carassius auratus),* the kissing gourami *(Helostoma temmincki), Osphronemus goramy,* the cichlid, *Tilapia mossambica,* and the snakeskin gourami *(Trichogaster pectoralis).* Some of these, of course, are not indigenous and have been introduced from other lands. Yes. Borneo is a mysterious island for the aquarist in more ways than one!



FROM TOP TO BOTTOM:
Nemachilus selangoricus
Betta unimaculata
Nandus nebulosus
Periophthalmodon tredecemradiatus
Tetraodon leiurus

NOTE: Readers interested in learning more about Bornean fishes are urged to read *The Freshwater Fishes of North Borneo*, by Robert F. Inger and Chin Phui Kong (Fieldiana: Zoology, Volume 45, 1962), available from the Chicago Natural History Museum. It is the finest recent account of the fishes of Borneo and very readable.

The Annuals of the Plant World
The Aponogetons

[Tropicals Magazine, July-August 1963]

Aponogeton is a plant genus that, although it does not possess the widespread appeal of the swordplants or the cryptocorynes, nevertheless contains some of the most magnificent center plants available to the aquarist. As such, they are connoisseur's plants and for all the idiotic raving that has gone on in the past, no plastic imitation has even begun to approach the real article.

Unfortunately, however, the aponogetons are characteristic of those plants found in shallow waters undergoing cyclical periods of dryness. Under these conditions, the rhizomes (tuberous roots) often lie dormant in dried mud only to bloom once again when the rains come. In this they are, perhaps, first cousins to the annual killifishes! These habits are carried over to aquarium specimens and it is usual for members of this genus to go through a resting period in the aquarium during part of the year. During this period all leaves are lost and the aquarium planted with aponogetons is merely a ghost town devoid of vegetation. From a cultivation standpoint, a drop in water temperature at this point (to as low as 50°F! … but not with fish present, of course) encourages a more vigorous growth when stems and leaves again make their appearance.

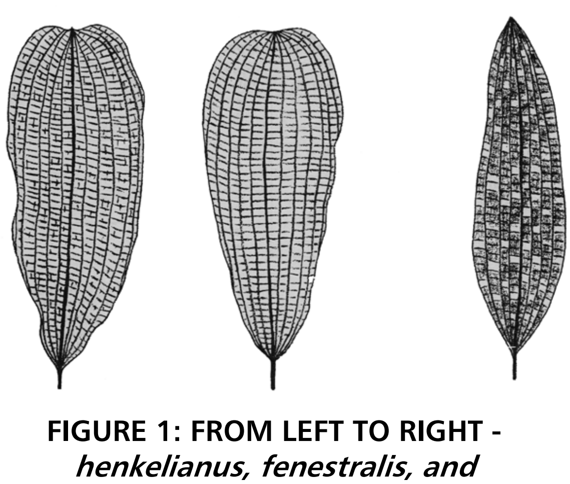


FIGURE 1: FROM LEFT TO RIGHT - *henkelianus, fenestralis, and bernierianus.*

It is convenient to place the aponogetons into three groups: the lace plants, the rippled leaf aponogetons, and the floating leaf aponogetons. This is not a scientific classification to be sure but it is useful from an aquarium standpoint. To make matters worse, hybrids occur within all three groups so a really firm classification is difficult to erect. The lace plants are strictly endemic to the island of Madagascar and are represented in the aquarium by three species: *Aponogeton fenestralis, A. bernierianus* and *A. henkelianus.*

The first is the well-known Madagascar lace leaf plant. With the aid of Figure 1 and Table I, the differences among these species are easily explained. *Aponogeton henkelianus is* very similar to *A. fenestralis* but does not possess the regular veins of the latter. In addition, its stems are redder and its foliage tends to brown rather than green. Also, it has an egg-shaped rhizome whereas the rhizome of *A. fenestralis is* cylindrical. There is a subspecies of *A. fenestralis,* variety major, that is larger and lacks the point to the leaf that characterizes the more commonly seen plan. The younger leaves of *A. bernierianus* contain almost no holes whereas the older leaves have many, sometimes even to the extent of resembling *A. fenestralis.* In general, however, the leaf holes of this plant are not quite as developed.

The general difficulty in the identification of the rippled-leaf aponogetons has been the eagerness of the genus as a whole to form hybrids among its member species. Thus, there have developed crosses such as *A. fenestralis x A. ulvaceus, A. fenestralis x undulatus, A.*

TABLE I – THE LACE PLANTS					
Name	**stem**	**Leaf length, inches**	**Leaf length, inches**	**Leaf**	**number of longitudinal ribs**
A. fenestralis	**4-8**	**12**	**2-1/2 to 3**	**Olive to dark green**	**11-13, sometimes 15-17**
A. fenestralis, variety major	**6-10**	**16**	**5-1/2 to 6**	**"**	**"**
A. berniernianus	**2-8**	**8**	**1-1/2**	**Light to dark green**	**5, sometimes 7-9**
A. henkelianus	**4-8**	**18**	**6-7**	**Olive to dark green**	**11-13, sometimes 15-17**

natans x A. undulatus and *A. crispus x A. undulatus,* to name but a few. The identification of these hybrids is very difficult. Among the four rippled-leaf aponogetons, two pairs are easily confused. Between the first pair, *A. crispus* and *A. undulatus,* there are a number of differences that the aquarist can observe and these are summarized in Table II. Briefly, the former is a much larger plant with a finely crinkled leaf. Crinkling, in this case, is not to be confused with rippling which is merely the undulation of the leaf border. Rather it denotes a fine, seersucker texture present throughout most of the surface of the leaf. These two plants are not frequently seen in aquaria. More commonly seen is the simple *A. crispus* x *A. undulatus* cross which has a wedge-shaped base to the leaf and lacks the fine crinkling.

TABLE II: THE RIPPLED LEAF APONOGETONS								
Name	**Stem length, inches**	**Leaf length, inches**	**Leaf width, inches**	**Leaf border**	**Base of leaf**	**Number of ribs**	**Leaf shape**	**Leaf color**
A. crispus	**12-14**	**10-12**	**1-2**	**Rippled, also crinkling throughout leaf**	**Rounded or weakly heart-shaped**	**7, sometimes 9**	**Elongated lineal to lancet**	**Bright to dark green**
A. undulatus	**2-4**	**5-6**	**1-1/4 to 2**	**Rippled**	**Blunt or stubby**	**5**	**Lancet**	**Bright to dark green**
A. elongatus	**4**	**8-12**	**1-1/4 to 2**	**Rippled**	**Runs into stem**	**5-9**	**Elongated oval to lancet**	**Bright green**
A. ulvaceous	**10-12**	**14**	**1-1/4 to 3**	**Strongly rippled**	**Wedge-shaped**	**5-9, sometimes up to 13**	**Elongated oval, elliptical lancet or band-like**	**Bright green (rarely dark)**

The second pair that provides for some confusion also *is A. elongatus* and *A. ulvaceous.* However, the latter has a larger leaf and much longer leaf stems. The rippled leaves of the four members of this group make identification from pictures extremely difficult, Table II being better for this purpose.

The last group, the floating-leaf aponogetons, contains three species that aquarists have encountered at one time or another. *A. elongatus* also produces a floating leaf but this is a rare occurrence. The floating-leaf aponogetons considered here are *A. leptostachyus, A. distachyus,* and *A. natans.* The first two species are represented by two subspecies apiece but they are of little interest to aquarists. This really applies also to the whole group for these floating-leaf aponogetons are active only during a short part of the year, require very bright illumination and are used to much colder temperatures than are provided in tropical fish aquaria. They are useful, however, in outdoor ponds.
Although they all produce submersed leaves at first, the plants quickly develop floating leaves, reducing their utility to the aquarist. Soon after producing floating leaves, the submersed ones decline (especially in the case of *A. natans).* The floating leaves of these three plants are similar, i.e., elongated oval or elliptical to lancet-like, with 5 to 9 longitudinal ribs, 7 being the most usual number. The largest plant is *A. distachyus* with a leaf length to 10 inches. The other two have leaves of 4-inch length, but *A. natans* with its leaf width of only one inch is narrower than *A. leptostachyus* with its two-inch wide leaf. In general then, this group is better suited to the pool than to the aquarium.

As a postscript to these aponogetons, Table III summarizes the habitats and leaf forms of some aquarium members of the genus. Nomenclature among plants is often in a precarious state and it must be stressed that the situation is particularly bad with *Aponogeton.* Perhaps as scientists learn more about this genus, aquarists will be provided with names in which more trust may be placed.

An Aquarist's Look At South America - Part 1

[Tropicals Magazine, September-October 1963]

Like Africa, South America is mostly plains and plateaus. The continent is divided roughly into three longitudinal zones (from east to

TABLE III – ORIGIN AND LEAF TYPE OF APONOGETONS

Name	Asia	Africa	Australia	Submersed leaf	Floating leaf
A. bernierianus		*		*	
A. crispus	*			*	
A. distachyus		*			*
A. elongatus			*	*	*
A. fenestralis		*		*	
A. henkelianus		*		*	
A. leptostachyus		*			*
A. natans	*		*		*
A. ulvaceous		*		*	
A. undulatus	*			*	

west); the cordilleras of the Andes, the lowland belt and the plateaus of the Guianas and Brazil (see figures 1 and 6). As aquarists, we will be concerned with the last two for these are areas in which important aquarium fishes are found.

The lowlands of South America include the llanos of the Orinoco, the Amazon plains and the Chaco and Pampa of Argentina. This belt forms a more or less continuous strip from the mouth of the Orinoco River down to the Patagonian area of Argentina. However, we shall be concerned again, only with that portion extending as far south as the Chaco (northern Argentina). In regions of heavy rainfall (see figure 2), the alluvial soils are almost entirely distributed by water. In the Chaco, where the rainfall is seasonal in nature and the network of Andean streams does not reach far into the lowlands, this transportation is assisted by winds during the dry season. Many aquarium fishes (notably killies) are found in these South American lowlands.

There are five important river drainages in South America: Magdalena, Orinoco, Amazon-Guianas, Sao Francisco, and La Plata. The

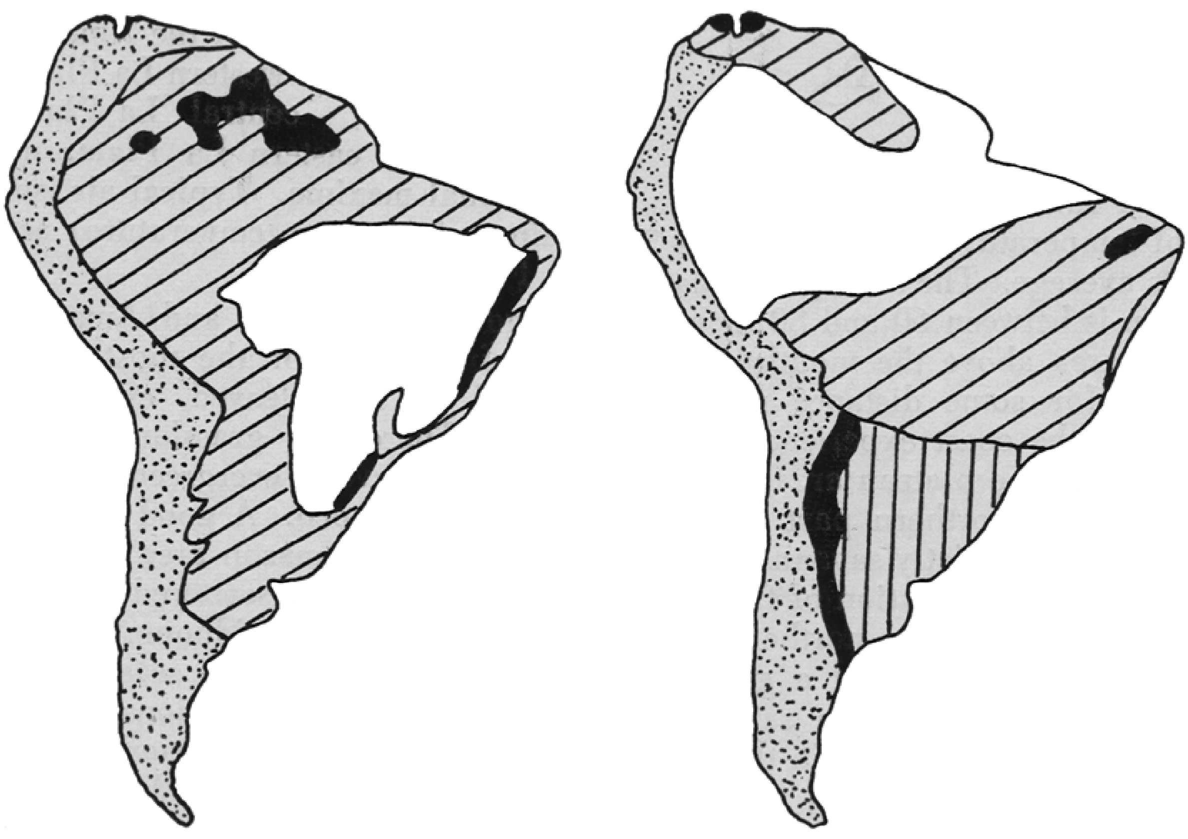


Figure 1 (left) : Land forms of South America (excepting western and extreme southern parts). Codes: solid - hill lands; white - plateau and tablelands; diagonal - plains; dotted - not of interest. Figure 2 (right) : Climates of South America (excepting western and southern parts). Codes: solid - low latitude steppe (continuously hot, little precipitation); white - rainforest; diagonal - savanna; vertical - subtropical, moist (warm summers, cool winters, moderate precipitation in all seasons); dotted - not of interest.

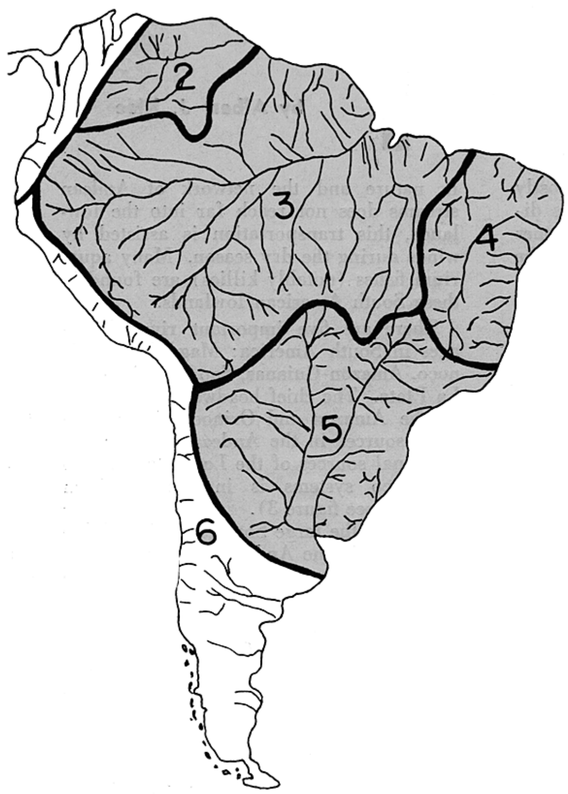


Figure 3: Important River Drainages of South America;
1. Magdalena
2. Orinoco
3. Amazon-Guianas
4. Sao Francisco
5. La Plata
6. Others (not of interest).

chief headwater tributaries of the Amazon and Orinoco rivers have their sources in the Andean plateau; the principal sources of the La Plata and Sao Francisco systems is in the Brazilian plateau (see figure 3).
Most of the large South American lakes are found in the Andes or along its base. There are many lakes scattered over the flood plains of the river systems noted, but these are mostly phases of river development.

The northern plains area of South America (Amazon-Guianas basin) consists of a rainforest. Here, the seasonal range of temperature

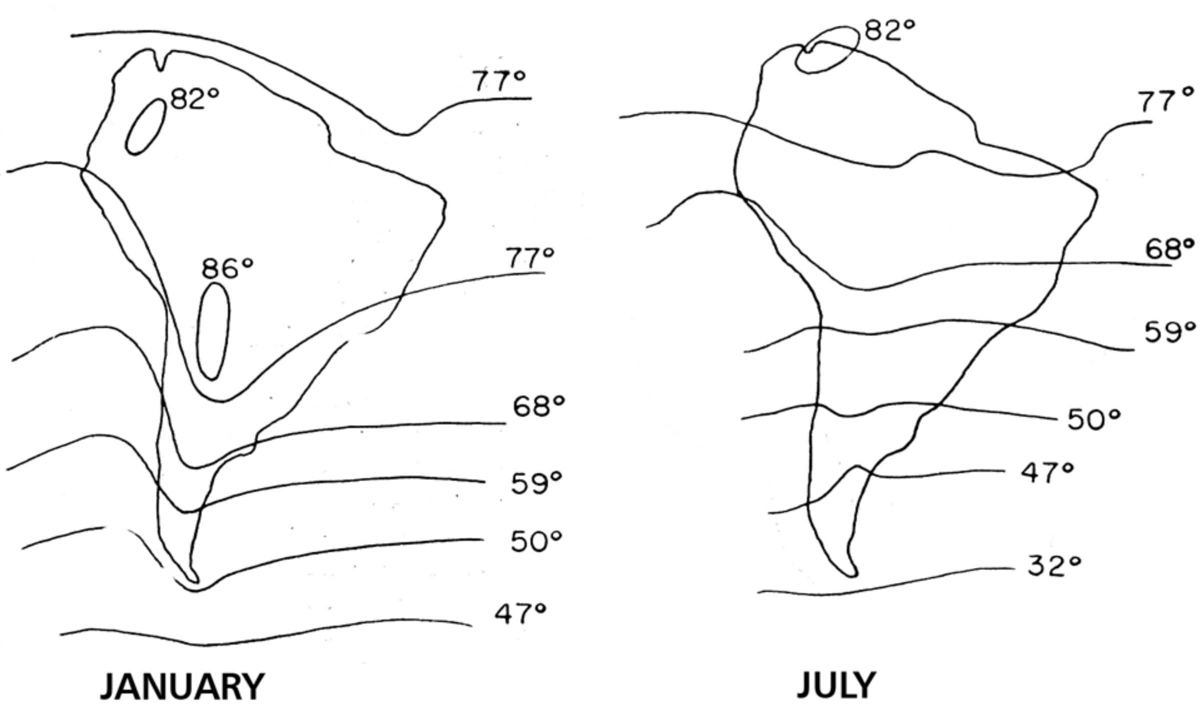
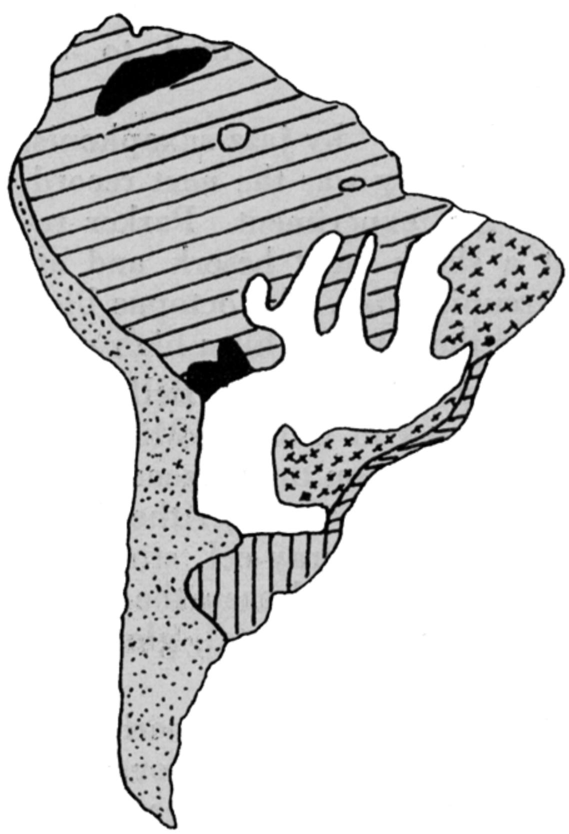


Figure 4:
Isotherms of South America for selected months (air temperature at ground level).

varies less than 5° F from its average. The average annual precipitation is between 60 and 80 inches, although the area above the mouth of the Amazon and for some distance north and south along the coast experiences more than 80 inches. The plateau area of middle South America (northern part of the La Plata system) is strictly savanna with a seasonal temperature variation of from 5° to 15° F. Surprisingly, the northern part of the Magdalena basin and a good deal of the Orinoco basin is also savanna, however, the seasonal variation in these parts is less than 5° F. In general, the savanna areas experience an average annual precipitation of from 40 to 60 inches. The southern part of the La Plata basin is a subtropical moist climate, with warm summers and cool winters. Here, there is moderate precipitation in all seasons, with summer maximums. However, the seasonal range of temperature is greater (varying from 15° to 30° F) and the average annual rainfall is less (between 20 and 40 inches).

The coldest and warmest months in the Amazon basin are March and September, respec-



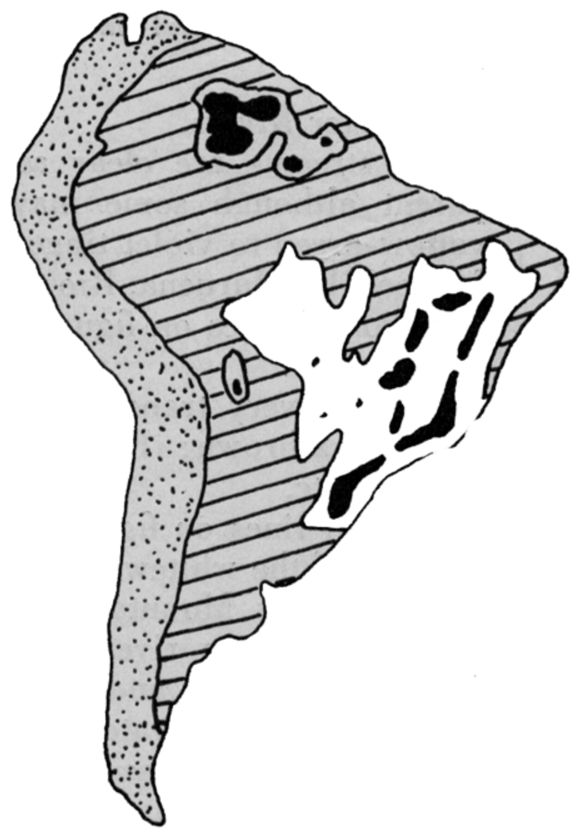


Figure 5 (left): Vegetation profile of South America (excepting western and extreme southern parts). Codes: solid - grasslands with scattered broadleaved evergreen trees; diagonal - broadleaved evergreen forest; white - grasslands with scattered broadleaved deciduous trees; crosses - broadleaved deciduous forests; vertical - grasslands; dotted - not of interest. Figure 6 (right) : Topography of South America (excepting western and extreme southern parts). Codes: solid - 3000 to 6000 ft.; diagonal - 1000 to 3000 ft.; white - 0 to 1000 ft.; dotted - not of interest.

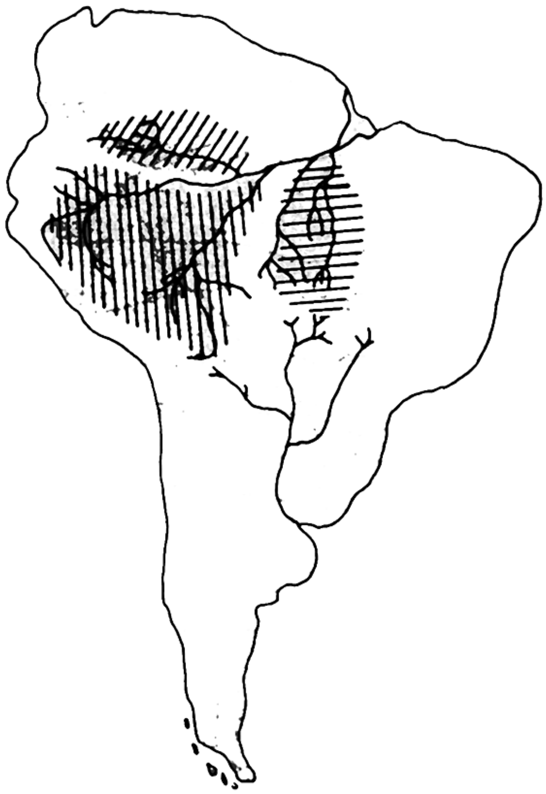


Figure 7: Approximate locations of the major river types of South America. Code: Vertical lines - Whitewater Rivers; Horizontal lines - Clearwater Rivers; Diagonal lines - Blackwater Rivers.

tively. In the Orinoco it is January and May; in the Magdalena, January and July; in Sao Francisco, July and December; in the La Plata, July/August and January. Seasons of maximum precipitation are as follows: northern Magdalena and Orinoco, summer maximums; northern Amazon and Guianas, two seasonal maxima - spring and autumn; areas around the mouth of the Amazon, spring maximums; northeastern Sao Francisco, autumn maximum; the rest of the Amazon basin, Sao Francisco and western La Plata, summer maximums; central La Plata, winter maximums; eastern La Plata, no marked seasonal maxima. Typical air isotherms (lines of constant temperature) are shown in Figure 4.

The Magdalena, Orinoco, and Amazon-Guianas basins have, for the most part, vegetation of the broadleaved, evergreen forest type. There are grasslands wish scattered broadleaved evergreen trees, however, in the Orinoco. A good portion of this area and the Amazon area bordering it is grassland with scattered broadleaved deciduous trees (deciduous: falling off at maturity, or at certain seasons, as with some leaves). Some portions of the La Plata basin also have vegetation of this type. The remainder of the La Plata basin has forests of evergreen and deciduous broadleaved trees, or needle leaved evergreen trees (see figure 5).

Most of the soil of the aquarium fish areas of South America are lateritic (similar to African rainforest soils, i.e., very poor in humus) although some prairie types and reddish chestnut soils are found in the La Plata (these are similar to African savanna soils).
The streams of the Amazon basin can be classified within three groups as follows:

1. Whitewater Rivers.
Turbid water that is milky-colored as a consequence of concentrations of silt clay: Rio Madeira, Rio Solimoes, Rio Amazona, etc. (vertical lines on figure 7).
(2) Clearwater Rivers.
These streams are clear and transparent although some may have a yellow-green to violet tinge: Rio San Manoel, Rio Juruena, Rio Xinga, etc. (horizontal lines on figure 7).
(3) Blackwater Rivers.
Clear and very transparent but colored dark-brown: Rio Negro, Rio Cucuru, etc. (diagonal lines on figure 7).

The origin of the Whitewater Rivers is in or near the Andes Mountains. On their way to the sea, these rivers pick up inorganic materials (clay and silt), imparting turbidity to the water. These materials are derived from sedimentary rock or stone, a sort of crumbly mixture of clay and sand. Although these deposits settle out from the water in lakes (and finally in the ocean), they also settle out up on the surrounding land during the flood season. (Part II will appear in our next issue).

An Aquarist's Look At South America - Part 2

[Tropicals Magazine, November-December 1963]

The Clearwater Rivers, on the other hand, originate in the granite-bearing mountains of central Brazil and the Guianas. Through processes of weathering, all over-lying sediment has been washed away over the years, and nothing remains, for the most part, but granite. Thus, no inorganic material is carried along with the water. Such waters are very clear and rich in nutrients (see Table I). Analyses of Clearwater types show a remarkable lack of dissolved solids and consequently, an extremely low hardness. Thus, such waters exhibit not only low calcium and magnesium concentrations, but also low sodium concentrations as well. This is significant insofar as recent suggestions for the increased utilization of ion exchange resins in the aquarium are concerned. Such resins increase the sodium content of aquarium water considerably.

The Blackwater Rivers have their origin in the Clearwater Rivers. When the latter reach the flat Amazon basin, the riverbed widens and in the rainy season, large areas are inundated. During this time, the rivers overflow their banks and great quantities of organic material are leached from the forest floors and enter the rivers (see Tables II and III). As with the Clearwater types, the Blackwater waters are low in dissolved solids. From the analyses, it can be seen that the major differences between these two types occur in the high humic acid content and the high potassium permanganate consumption of the latter. The permanganate consumption is a measure of the amount of organic material in the water and as such, indicates that the Blackwater types rate high in organic content. It is interesting to note that this type is also high in iron.

TABLE I

Three Water Analyses from Lesser Streams, Clearwater Types

	#1	#2	#3
color	crystal clear	crystal clear	crystal clear
pH	4.8	5.2	4.8
temperature	76° F	75° F	75° F
free CO_2	14.0 ppm	11.9 ppm	16.6 ppm
bicarbonate CO_2	2.2 ppm	2.2 ppm	0 ppm
permanganate consumption	8.02 ppm	9.91 ppm	23.0 ppm
total hardness	0.18 DH	0.25' DH	0.40 DH
iron	0 ppm	0.03 ppm	0.14 ppm
aluminum	0 ppm	0 ppm	trace
ammonium ion	trace	0 ppm	trace
nitrate	0.4 ppm	0.2 ppm	0 ppm
chloride	trace	trace	0 ppm
sulfate	0 ppm	0 ppm	0 ppm
phosphate	0 ppm	0 ppm	0 ppm
organic acids ("humic acid")	0.05 ppm	0.025 ppm	0.075 ppm

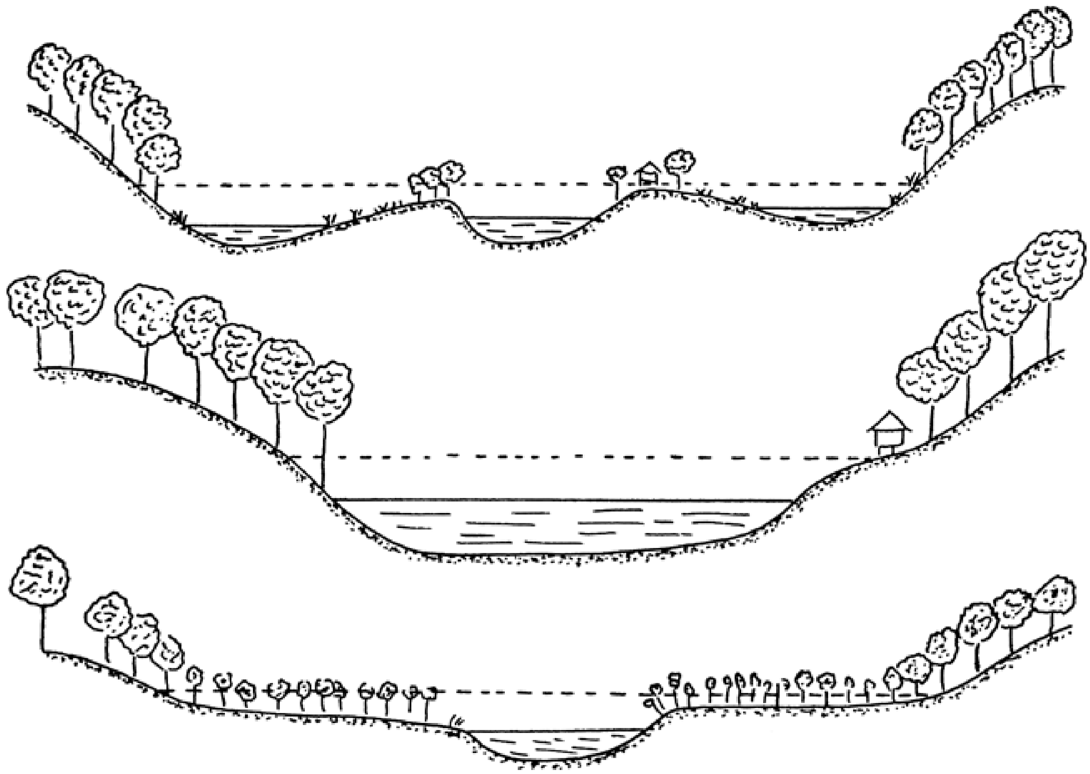


Figure 1: Cross-section of the three river types of South America: A, Whitewater River; ¦B, Clearwater River; C, Blackwater River. Dotted lines show water surface at flood stage.

We may summarize these three river types as follows:

(a) Whitewater Rivers: Contain sediment; milky-white in coloration; poor in calcium. Greatest hardness, 3 DH; very poor in infusoria and higher food organisms. Stream velocity relatively low.

(b) Clearwater Rivers: No sediment; water transparent and clear. Very poor in calcium; hardness less than 0.5 DH; nitrates, sulfur compounds and chlorides absent; pH mostly between 6.5 and 7.0. Rich in foodstuffs such as bosmina, daphnia, and cyclops. Very rich fish fauna. Stream velocity moderate.

(c) Blackwater Rivers: Brown or blackish-colored; very poor in calcium; many free acids (e.g., tannic acid); pH mostly between 4.5 and 5.0. Very poor in food animals. Moderate fish fauna. Stream velocity relatively low.

When the rains come, two influences are especially notable. The water, already poor in calcium, becomes even poorer, due to the tremendous dilution that takes place. In fact, the hardness approaches zero at this time in many places. By overflowing its banks, much trash and debris is picked up by the water. In the whitewater flood regions, the area inundated during these rains is known as the "varzea" and is nothing more than swampy land normally separated from the river by its banks (figure 1-A). In the Clearwater area, however, flood time is merely a matter of higher water levels but still contained within the river's banks (figure 1-B). The situation is quite dif-

TABLE II		
Two Water Analyses from the Rio Negro		
	#1	#2
color	brown	reddish-brown
temperature	80°	81° F
pH	4.2-4.3	4.5
free CO_2	1 1.2 ppm	7.0 ppm
bicarbonate CO_2	0 ppm	0 ppm
permanganate consumption	71 ppm	42 ppm
total hardness	0.14 DH	0.25 DH
calcium	1 ppm	1.8 ppm
iron	0.19 ppm	0.22 ppm
aluminum	trace	trace
ammonium ion	detected	detected
chloride	trace	trace (less than 0.5 ppm)
silica, SiO_2	2.5 ppm	2.5 ppm
sulfate	not detected	not detected
phosphate	not detected	not detected
organic acids ("humic acids")	0.075 ppm	0.075 ppm

TABLE III			
Three Water Analyses from Lesser Streams, Blackwater Types			
	#1	#2	#3
Color	brownish to dark-brown	brownish to dark-brown	brownish to dark-brown
pH	less than 4.1*	less than 4.1	less than 4.1
temperature	75° F	75.° F	74° F
free CO_2	14.1 ppm	16.4 ppm	13.9 ppm
bicarbonate CO_2	0 ppm	0 ppm	0 ppm
permanganate consumption	141.0 ppm	92.3 ppm	74.0 ppm
total hardness	0.15 DH	0.12 DH	0.15 DH
iron	0.18 ppm	0.15 ppm	0.25 ppm
aluminum	trace	trace	trace
ammonium ion	strong trace	strong trace	strong trace
chloride	trace (under 0.5 ppm)	trace (under 0.5 ppm)	trace (under 0.5 ppm)
nitrate	0 ppm	0 ppm	0 ppm
sulfate	0 ppm	0 ppm	0 ppm
phosphate	0 ppm	0 ppm	0 ppm
organic acids ("humic acids")	0.125 ppm	0.10 ppm	0.060 ppm

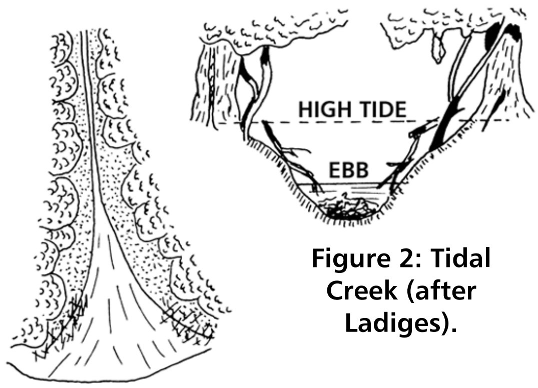


Figure 2: Tidal Creek (after Ladiges).

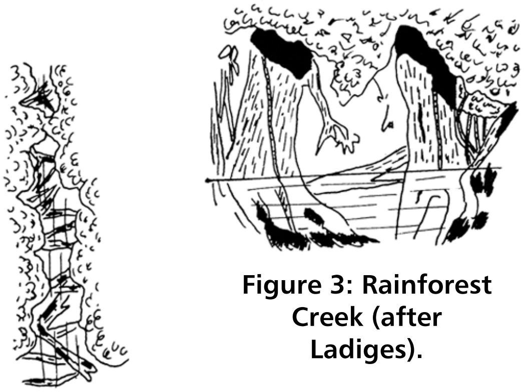


Figure 3: Rainforest Creek (after Ladiges).

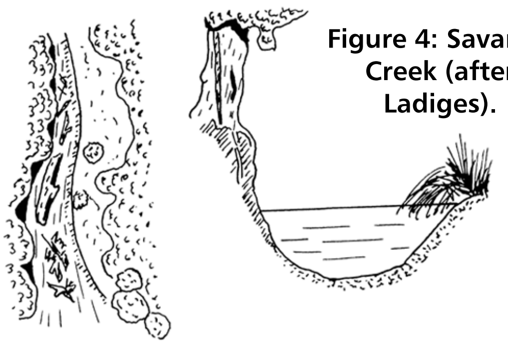


Figure 4: Savanna Creek (after Ladiges).

ferent in the black-water areas since these rivers overflow the woods along the river (the "Igapo") and pick up large quantities of humus (figure 1-C).

So far, we have discussed South America as if its fishes were found only in the great rivers themselves. Actually, nothing could be further from the truth. However, the reason for a discussion of the major river types is that the rivers themselves influence their side streams to a considerable extent. One of the reasons why so many South American fishes are overlooked by collectors is that they are found mostly in the really small bodies of water of this continent, often in almost inaccessible areas. There are a number of categories of such waters:

1. Tidal Creeks: These waters are affected by the tides and are, of course, encountered along the coastal areas (see figure 2). Their depth varies with the tidal period. Due to these tidal movements, quantities of woody materials, mud and leaves, tend to collect on the bottom. In general, these waters are shaded by surrounding vegetation and may be more or less brackish.

2. Rainforest Creeks: Jungle creeks are definitely shaded, little sunlight penetrating to them. A characteristic brownish or reddish cast is given to the water by virtue of its close contact with wood and humus materials (see Figure 3). Such streams are exceedingly difficult to reach, much less fish. Due to the constant leaching, the upper bottom layer is mud or humus but we find mostly fine sand underneath as the major substrate.

3. Savanna Creek: These creeks are little shaded from the sun, and water temperatures range from 84° to 95° F during the dry season (lower, of course, during the rainy season). Such creeks sometimes have shores free of plant growth, containing perhaps but a few bushes or isolated trees. Grass, however, is frequently present (see figure 4).

Thus, we find as many water types in South America as we do in Africa although the leaching process is carried out to a further extent in the former. But in any event, the South American continent provides us with diverse habitats. Many *Rivulus*, for example, are found in swampy, grass-overgrown water of the most Lilliputian dimensions. Some are found in rocky areas in the vicinity of waterfalls. *Cynolebias* and *Pterolebias* are found in habitats that do not differ very much from their *Nothobranchius* counter-parts in Africa. As it has been an error on the part of many aquarists to think of Africa entirely as a thick jungle, so it is to consider the South American continent in t h e same way. But where the important savanna areas of Africa are found in the north and the east, in South America they are found in the south and the northwest.

There are still great unexplored regions of South America, especially with regard to its fish population. The information that is available is sketchy and together with the inevitable gaps in our knowledge of the ecology of individual species of fishes, it is not surprising that South America should vie with Africa for the title, "Dark Continent."

A New *Epiplatys* from the Ivory Coast

[Tropicals Magazine, November-December. 1963]

In considering other than the moderately handsome old standby, *Epiplatys chaperi*, most of the interest in this genus of killifishes revolves merely about the almost unique, pike-like appearance of many of its species. This is an injustice, however, because there are species within the genus that can hold their own with the best of many other genera. *Epiplatys duboisi*, a fish of extraordinary beauty, is a case in point. Our subject here, however, is another handsome member of the genus, new not only to aquarists but fairly new to science itself. In 1960, Mon. J. Arnoult, of the Museum National d'Histoire Naturelle (France), described a new fish, viz., *Epiplatys spillmanni* (pronounced **SHPILL'**-MUN-EYE). For reasons to be discussed shortly, I consider this fish to be conspecific (i.e., the same species) with *Epiplatys sheljuzhkoi* (pronounced SHELL-**JEWSH'**-KO-EYE) but perhaps of subspecific rank, i.e., *Epiplatys sheljuzhkoi spillmanni*. This fish, which was named in honor of Mon. Arnoult's colleague, M. J. Spillmann, was discovered in 1959 in the Ivory Coast within a radius of about 60 miles of Bouake (see Figure 1). This region is transitional between the rainforest and the savanna (i.e., a "derived" savanna), and is host to many impressive rivers such as the Nzi, Bandama Blanc, Kan and the Comoe. Specimens of the new *Epiplatys* were taken from small streams, brown with the acid of leached tannin, in the vicinity of Bouake, the village of Kan, and the environs of Nanafoues. In nature, it exhibits an aversion to bright, sunny areas and so the original specimens were found mainly among the leaves of Pistia stratiotes, a plant almost ubiquitous throughout tropical Africa. The fish, however, was not found in association with any other killifishes.

In his original description, Arnoult compared *Epiplatys spillmanni* with *chaperi*, sexfasciatus, dageti, and olbrechtsi, finding it to differ from all of them. For some unexplained reason, however, he did not compare it with *Epiplatys sheljuzhkoi* for if he had, he almost certainly would not have described it as a new species. The meristics (fin, scale counts) of both forms are statistically identical and their patterns and coloration are very similar, also. Since the original *E. sheljuzhkoi* appears to be a coastal form (see Figure 1), it is suggested that the differences that do exist are geo-

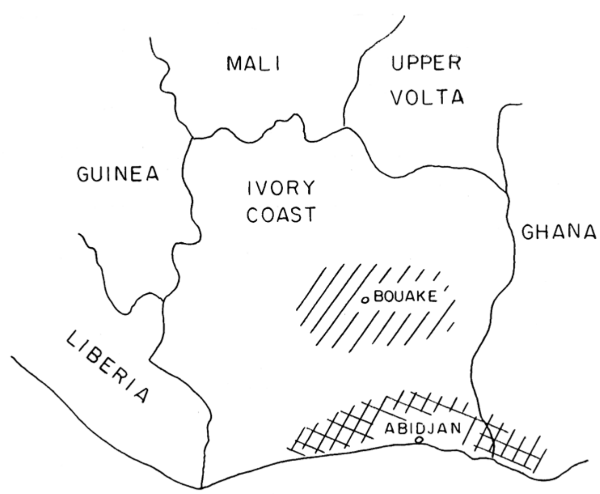


Figure 1: DISTRIBUTIONS OF *Epiplatys sheljuzhkoi* IN THE IVORY COAST
Diagonal lines = *Epiplatys s. spillmanni*
Cross-Hatched lines = *Epiplatys s. sheljuzhkoi*

Figure 2: Male (above) and female *Epiplatys sheljuzhkoi spillmanni* (after Arnoult)

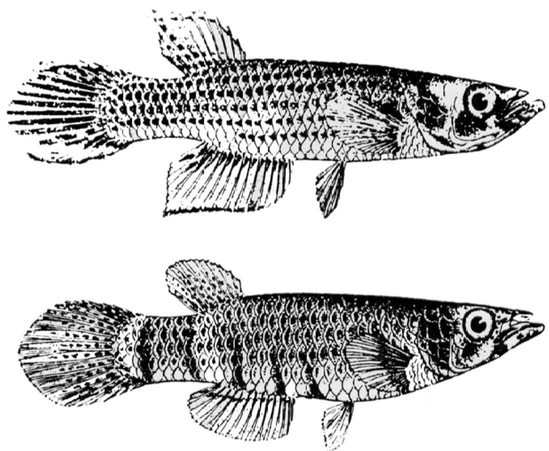


Figure 3: Male (above) and female *Epiplatys sheljuzhkoi sheljuzhkoi* (after Poll)

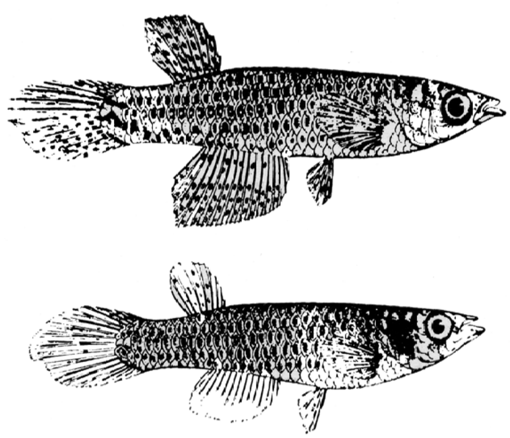


Figure 4: Male (above) and female *Epiplatys macrostigma* (after Poll)

graphic in nature and accordingly, that *spillmanni* is at best a subspecies of *sheljuzhkoi*. The differences between the two subspecies, if we may call them that, are shown in Figures 2 and 3, and are further summarized in the chart.

While on the subject of identification, it should be mentioned that aquarists are frequently puzzled by the differences between *E. sheljuzhkoi* and *E. macrostigma*. There is no doubt that they are often confused. I can well understand this confusion because the now-famous photograph of *E. sheljuzhkoi* by Mervin F. Roberts was published in the AQUARIUM (pg. 217, July 1954) and in T.F.H. (pg. 25, Nov.-Dec. 1954) under the erroneous caption of "*Epiplatys macrostigma*," even though one of these articles purported to "explain" the difference between these two species! The error originated, however, with Dr. Meder's description of *E. sheljuzhkoi* as "*E. macrostigma*" in DATZ, No. 6, 1953. *Epiplatys macrostigma* is native to the Congo basin and basically differs in that, unlike in *E. sheljuzhkoi*, females are not barred. It is, in addition, more delicately shaped. Figure 4 shows sketches of a male and female *E. macrostigma* ... these should be compared with Figures 2 and 3.

It should also be mentioned in passing that the well-known German aquarist, Mr. Herman Meinken, has recently synonomized *sheljuzhkoi* and *macrostigma* with *Epiplatys chevalieri* (another Congo species). For sundry technical reasons, however, I cannot agree with him. It is interesting to note that Mr. Meinken originally reported *E. chevalieri* in DATZ (no. 3, 1950) under the designation of "*Aphyosemion* species," and a year later, as "*Epiplatys macrostigma.*" That the species mentioned above are closely related there is no doubt but many rather clear-cut differences exist (we shall show one of them later on, i.e., a difference in egg size). Furthermore, too many aquarists of late have ignored the fact that genetic isolation is only one basis for speciation, and that other bases are also equally real and valid.

The male *Epiplatys sheljuzhkoi spillmanni* (Figure 5) has a basic body coloration of blue to bluish-green, the sides being covered with rows of red spots. In addition, there are present red markings on the gill covers and the head, plus rather prominent crossbars from pectoral fin to tail root. The dorsal fin and the upper and lower portions of the caudal fin are bordered in light blue and submargined in black; the anal fin, however, is simply bordered in black. In general, these fins are yellow to yellow-green and are covered with numerous red dots. Females (also see Figure 5) are much less colorful, have fewer spots, lack the dark fin borders, and have shorter fins. Males reach about 21/2 inches in total length, females are somewhat shorter.

Epiplatys sheljuzhkoi spillmanni eats almost everything — my own fishes relishing frozen adult brine shrimp, liver and chopped beef. Although the type species is somewhat aggressive, I have not known *spillmanni* to be a finnipper. It seems to do well with other fairly robust killifishes in aquaria of moderate size (8 to 15 gallons).

Breeding poses no problems and for this purpose I use a 5-gallon, bare-bottomed tank provided with floating, nylon spawning mops. Although their eggs are small (1.3 mm average diameter), they are still larger than those of *Epiplatys macrostigma* (1.0 mm average diameter… see figure 6). Production is high and several hundreds of eggs per week may easily be obtained. My experience suggests that they will lay their eggs anywhere on a floating mop, from top to bottom, without particular preference whatsoever. Furthermore, they do not seem to be as fond of their own spawn as do other members of the genus. The fry hatch after 7 to 14 days (the upper figure is from the literature; my own experience, however, is that they hatch in from 7 to 10 days) and although moderately small at birth, they can be started immediately on newly hatched brine shrimp. Rearing the fry to adulthood is very easy, with standard methods applying in every instance.

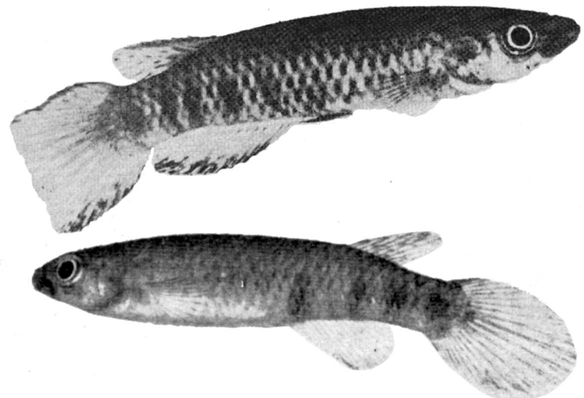


Figure 5
Top: Male Epiplatys *sheljuzhkoi spillmanni.*
Bottom: Female *Epiplatys sheljuzhkoi spillmanni.* Photos by Albert J. Klee

CHARACTERISTIC	*E. s. sheljuzhkoi*	*E. s. spillmanni*
Crossbars on adult males	Seldom visible; if present they are subordinated to the rather prominent rows of red spots	Always present; red spots present but not as prominent.
Coloration of the males	More colorful; chin is a brilliant cobalt blue.	Less colorful; very little blue about the head.

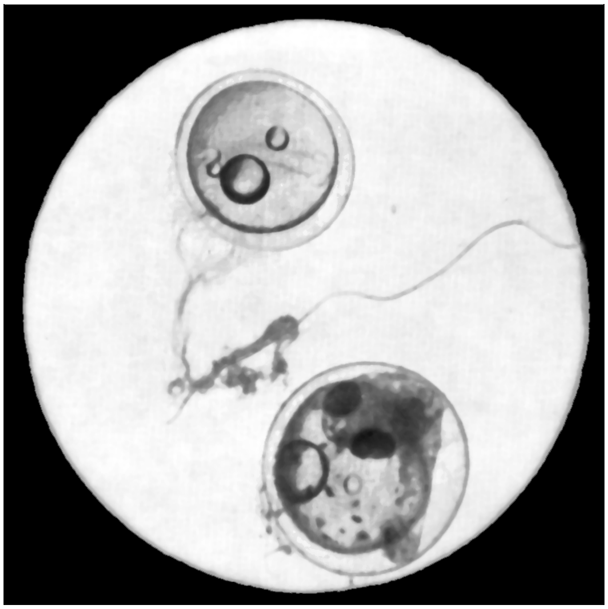


Figure 7
Eggs of *Epiplatys macrostigma* (smaller) and *Epiplatys sheljuzhkoi spillmanni*.

Although *Epiplatys sheljuzhkoi spillmanni* is not quite as handsome as its cousin, *Epiplatys sheljuzhkoi sheljuzhkoi*, it nevertheless is a fairly pretty Epiplatys that should be seen more often in the aquarium. It shows up especially well under Gro-Lux lighting as such lighting enhances its blue and red markings.

ACKNOWLEDGEMENT
The author wishes to thank Col. I. J. Scheel for his kind assistance in providing references to the original description of *Epiplatys spillmanni*, and for his comments regarding the validity of this fish as a distinct species.

A New Kind Of Zebra

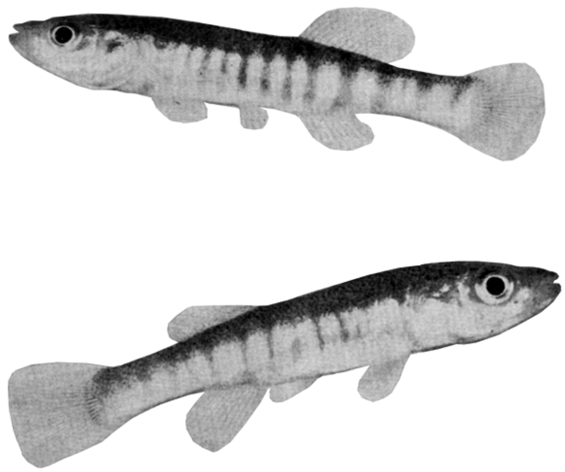
[Tropicals Magazine, January-February 1964. Note: This article was co-authored with James D. Walker, AJK being the Senior Author.]

"Come, let us discourse about fish," said Athenaeus in his "Deipnososophistae," and so, we accept the invitation in order to bring to the attention of the readers of TROPICALS, two species of killifishes never before described in the aquarium literature. Such an excursion is always a pleasure to a hobbyist and we hope you find it so also. Our main satisfaction derives from the fact that the fishes in question are native fishes, but still exotic enough in spite of their origin.

Fundulus zebrinus was described in 1882 by Jordan and Gilbert (although first mentioned as "*Hydrargyra zebra*" by Girard in 1859). Aquarists searching through the older literature may encounter the term, "*Fundulus adinius*," but this is only a synonym for *F. zebrinus*. In 1895, Garman described *Fundulus kansae*. In brief then, these two fishes are the subjects of this article. Table I clarifies the nomenclatural picture further for we do not wish to bog the reader down in needless terminology for after all, **"What's in a name?"**

There is some discussion among ichthyologists whether or not these two species are distinct and separable. As a matter of fact, other than the fact that they are found in different geographical locations, aquarists will find it difficult to distinguish them. There are some real differences, however, and for the present, the authors prefer to consider them as two valid species.

In 1895, Garman proposed a new subgenus to accommodate *Fundulus kansae*, i.e., "*Plancterus*." Others elevated it to generic rank and thus, for many years, these fishes were known as "*Plancterus zebrinus*" and "*Plancterus kansae*." Garman based his subgenus on the fact that its members had a much longer intestine than members of *Fundulus*, plus reduced "throat teeth." However, these differences are nutritional adaptations and do not form' a very valid basis for a subgenus. Therefore, *Plancterus* is not used, either as a genus or as a subgenus, in up-to-date literature. Our experiences are basically with *Fundulus kansae* but for all intensive purposes,



TOP: FIGURE 1- Male *Fundulus kansae*.
BOTTOM: FIGURE 2– Female *Fundulus kansae*.

what can be said for one can be said for the other.

Fundulus kansae is a slender, elongated killifish with a large head and projecting lower jaw. The species attains a length of 6 inches but usually, most adults are less than 3 inches (as are our fishes). Our specimens are colored as follows (males): back brownish and covered with many tiny, reddish-brown dots; sides silvery with a pinkish-violet hue; 11 to 21 vertical, brown bands mark the sides; under parts of head yellowish-white; vertical fins faintly brownish and covered with a faint dusting of fine dark dots; black spot on back at base of dorsal fin; paired fins colorless to yellowish. Breeding males show considerable red or deep orange on the sides and lower fins (sometimes even the dorsal fin has a tinge of red).

Although we have been asked to outline sexual differences many times, this is not a particularly difficult problem. Certainly these differences are not as obvious as those between the sexes of a given *Aphyosemion*, but neither are they as obscure as those between the sexes of an angelfish. Table II summarizes these differences (also see figures 1 and 2).

Finally, *Fundulus zebrinus* is very similar to *F. kansae* and differs chiefly in that it has larger scales and a larger eye (see figure 3). So far as is known, its habits and behavior are similar to those of *Fundulus kansae*.

Those of us interested in natives always hope that other hobbyists will become interested also, to the extent that they will be motivated to collect their own specimens. For this reason, we provide the following information regarding the distribution of the two species in the United States:

1. *Fundulus kansae*: Shallow streams of the Great Plains from South Dakota (where it probably was introduced) to northern Texas (Red River) and New Mexico (Arkansas River). It is found in Clay and Howard Counties in Missouri, Pennington and Fall River Counties in South Dakota, the Niobrara River in Western Wyoming and the Platte River in Nebraska.

2. *Fundulus zebrinus*: Upper portions of the Brazos, Colorado and Pecos drainages of Texas and New Mexico, and from brackish waters on the Llano Estacado of northwestern Texas. This fish has sometimes been called the "Rio Grande killifish" because of its reported appearance in Brownsville, Texas. This is considered an error, however, and it is extremely

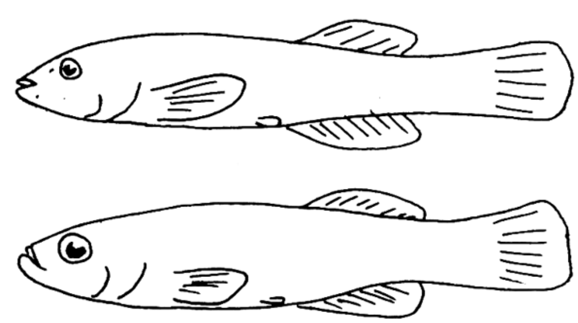


FIGURE 3:
TOP - *Fundulus kansae.*
BOTTOM - *Fundulus zebrinus.*

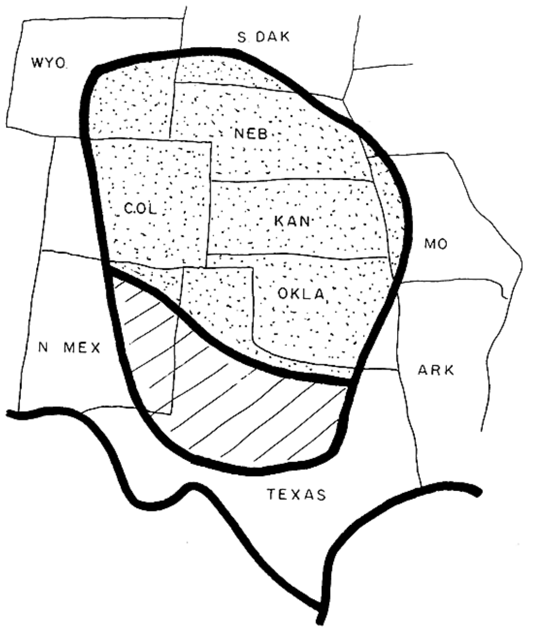


FIGURE 4: Distribution of the species.
DOTTED - *Fundulus kansae*;
OBLIQUE - *Fundulus zebrinus*.

doubtful that the species is found in this drainage.

Figure 4 denotes pictorially, the approximate range of these two species.

The natural habitat of our own specimens is the eastern edge of Palo Duro State Park in the north Plains area of Texas and in particular, in the Prairie Dog Town Fork of the Red River. This Park area is rich in fascinating and bizarre names, e.g., Devil's Tombstone, Goodnight Peak, Brushy Butte, Burnt Draw, and Fortress Cliff! The stream in which they were caught is a very odd one, especially to describe. It is largely underground, totally so for long stretches at a time. Furthermore, it seems to shift and change beds every so often, frequently isolating a pool containing several to many fish (see figure 5).

TABLE II	
MALE	**FEMALE**
Darker, wider	**Lighter, narrower**
Dusky, with many tiny dots; fins larger	**Clearer, fewer tiny dots; fins smaller**

The water, which is very hard, also contains silt or very fine clay, and forms a layer over much of the stream bed (see figure 6). The fish seem to swim in this layer of silt and one can follow them by observing the mud. Our specimens were all caught from waters less than 3 inches deep and mostly less than 1 inch. If the gravel bed is free of mud, the fish seem to school, however, aquarium specimens do not exhibit this behavior to any great extent. The water freezes in the winter although we have never checked this out personally (in this part of the country one does not go out into the canyons if the weather is cold … it is very easy to get trapped by a snowstorm).

We have caught *Fundulus kansae* in waters of 85° F and at no time have we found aquatic plants in this environment (only occasionally will the stream shift over a part of the stream bed that has other plants in it). Furthermore, we have found fish of all sizes in the same school, from about ½-inch to adult specimens. For some reason (probably because of a shortage of food), all of them appear rather hollow-bellied.

TABLE I			
TRIVIAL NAME	**PRONUNCIATION**	**MEANING OF NAME**	**POPULAR NAME**
zebrinus	**ZEE-BRIN'-US**	**Zebra-marked**	**Rio Grande killifish**
kansae	**KAN'-SEE**	**Of Kansas**	**Plains killifish**

William Koster also made observations on the natural habitat of specimens of *Fundulus kansae* in northeastern New Mexico, in a small, unnamed tributary of the "Dry" Cimarron River a few miles north of Moses, Union County. At the time of his visit the stream was small and clear, being shallow with an occasional deep pool. It varied from 3 feet wide and % inch deep, to 15 feet 'wide and 4 feet deep but was mostly between 4 and 7 feet in width and about 2 inches in depth. The bottom was chiefly gravel (the interstices filled with sand and silt) with some areas of sand or with scattered rocks. Its current was moderate but the vegetation consisted solely of Characeae and a very sparse growth of filamentous alga upon the stones. Koster also observed *Fundulus kansae* spawning in a pool of slow current, about 100 feet in length and varying in width from 4 to 8 feet and in depth from 2 to 4 inches (with a maximum depth of 10 inches). The bottom was gravel with sand and silt in the crevices.

Our specimens of *Fundulus kansae* prefer well-aerated water. One batch came down with ick shortly after being collected from the wild, but in general, the major problem with wild specimens appears to be in conditioning them and getting them to fill out. Their food in nature consists largely of assorted small animals obtained from both the bottom and the surface, but such were generally scarce in the habitat we investigated. Its surface food is mainly insects and floating matter, and it stirs up bottom forms from the muck by a quick, sidewise darting motion of the body. No problem is experienced in the aquarium in either keeping or feeding *Fundulus kansae*. Our own specimens greedily take adult, frozen brine shrimp, with smaller amounts of dry foods. One pair was housed in a 3-gallon tank with excellent results. Due to its "zebra-like" appearance, this fish receives many compliments, and forms the basis for many inquiries by visitors viewing the fish for the first time. Finally, it has the added advantage of being a peaceful inhabitant of the community aquarium. Mrs. Dorothy Blackburn of Beaumont, Texas, has recently reported to us that a pair of *Fundulus pulverous* placed into the same aquarium with her kansae, injured the latter badly, so perhaps *F. kansae* is too peaceful for its own good!

As spawning time commences, one observes the usual "territoriality" displays of male killies of the genus. These consist of erect fins and short, parallel swims when a rival male approaches. The spawning act itself is very simple. An "embrace" consists of both fishes arranging themselves alongside each other, turning on their sides with the male on top. Then they both assume the familiar "S-shape," and at the same time, the anal region of the fe-

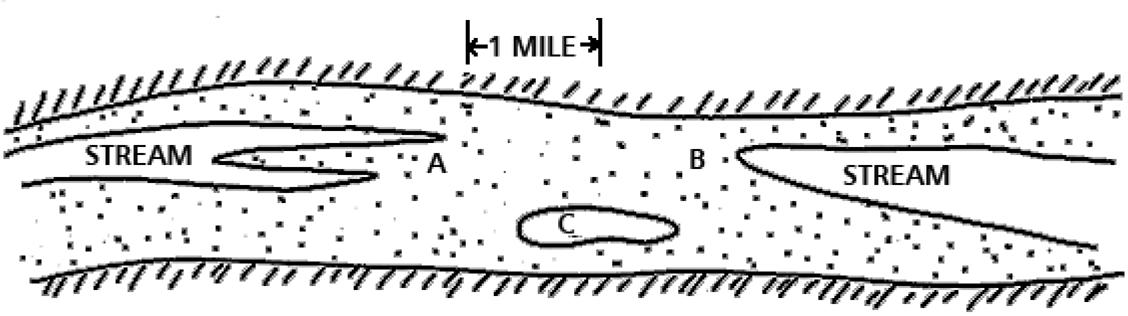


FIGURE 5: Top view of stream bed, home of *Fundulus kansae*.
A - Surface flow ends here, although water is moving.
B - Surface flow starts again, either from spring or underground stream.
C - Occasional isolated pool with fish, usually stagnant, however.

male is pressed to the bottom substrate (which in the aquarium is either peat or a bottom mop ... in nature it is mud or gravel). While in this position, they can be seen trembling, the eggs being released and fertilized.

During this time, the male is truly gorgeous because all pigmentation is highly intensified. Unlike in nature, *Fundulus kansae* will spawn (if in good condition … and this is the real problem with this fish) all year round. After spawning it is best to remove the parents if peat is used, or to remove the eggs if a bottom mop is used. Within two to three weeks, the fry will hatch out. The young of *Fundulus kansae* are heavily pigmented with melanophores about the top of the head (see figure 7), with a scattering also about the body. By the time they are approximately ¾-inch long, they are miniature editions of their parents. No difficulty is encountered in raising the fry since they will take brine shrimp nauplii from the very start.

Again, Nature has provided us with an excellent aquarium fish just for the asking. This silver "zebra" would be a welcome addition to any tank and if it came from Africa rather than the United States, it would be a prize indeed. The reason we mention Africa is that there is an African characin that resembles *Fundulus kansae* superficially. This is *Barilius christyi*, a rare fish usually commanding a high price. Sometimes we wonder about the logic of it all!

Erythrophoroma Nothobranchius

[Tropicals Magazine, March-April 1964]

There are a number of tumors of fishes known arising from pigment cells, probably the best publicized being the melanoma, a tumor derived from the melanophore (i.e., a black pigment cell). The late Dr. Myron Gordon, for example, did considerable research along these lines in studying melanomas of *Xiphophorus.* However, guanophoromas (from iridiocytes, i. e., cells containing guanine, the substance responsible for most of the irridescence of many fishes), xanthophoromas (from xanthophores, i.e., cells containing yellow pigment) and erythrophoromas (from erythrophores, i.e., cells containing red pigment) are also known. The first two are quite rare but even erythrophoromas are infrequently reported in the literature.

During the summer of 1963, I purchased a pair of *Nothobranchius orthonotus* (red variety … frequently but incorrectly known in the hobby as *Nothobranchius "melanospilus")* with a view towards establishing the species in my aquaria. Much to my disappointment, the male fish developed a nodule on his back, immedi-

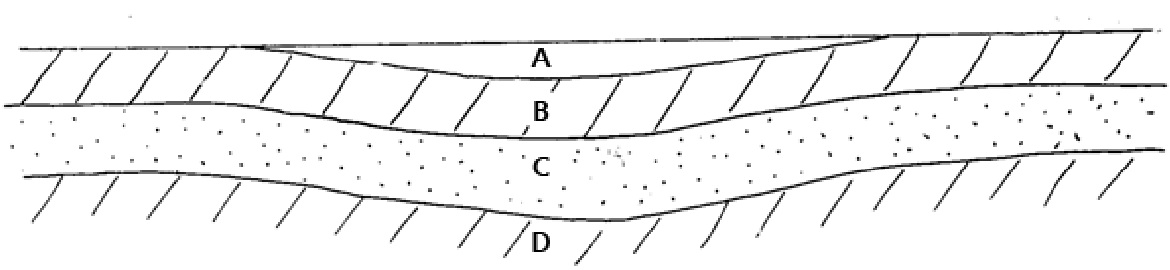
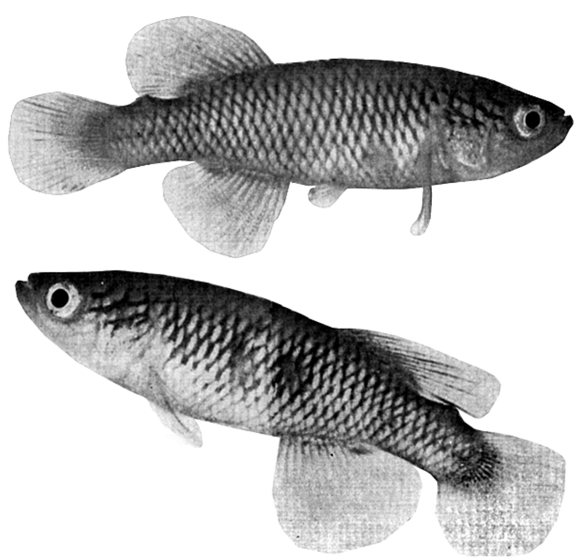


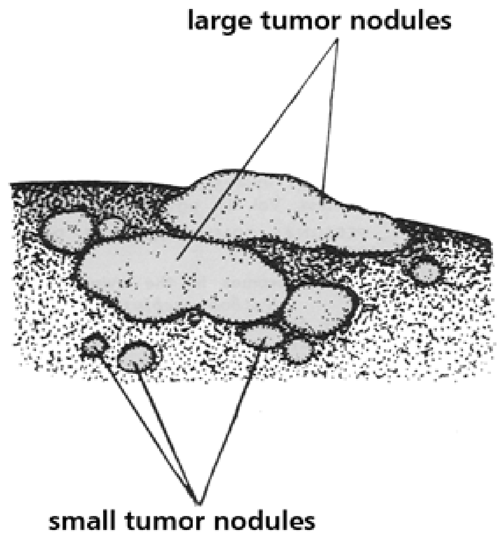
FIGURE 6: Cross Section of Typical Stream (Palo Duro Creek)
A - Water (0 - 6 inches deep)
B - Silt, fine red clay (0 -10 inches deep)
C - 5 to 10 mesh gravel
D - Generally blue clay (occasionally red)

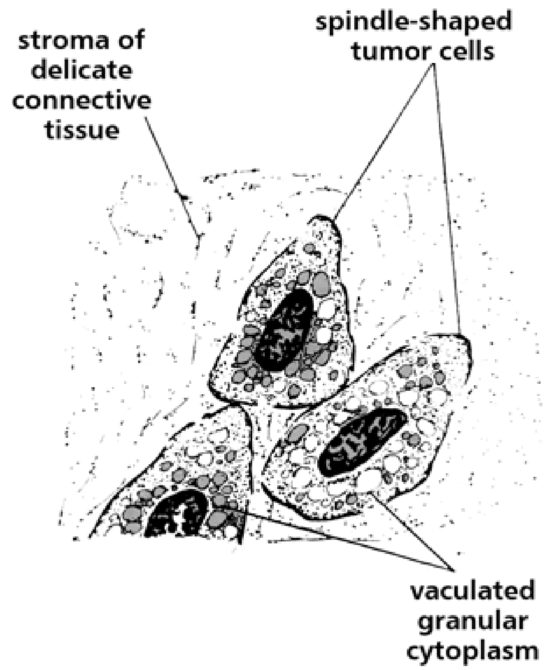
ately behind the dorsal fin (see figure 1). This growth, pinkish in coloration, was 4 mm long, 2 mm high, and 2 mm wide. Soon afterwards, additional growths developed on its sides (see figure 2) and it subsequently died. The growth resembled those found by Prof. A. Stolk on a specimen of *Nothobranchius guentheri* (see figure 3) and microscopic examination revealed similar spindle-shaped tumor cells embedded in a stroma of connective tissue (see figure 4). Although chemical analysis was not performed, many of the cells showed traces of reddish pigment granules, indicating the presence of an erythrophoromas.

After the death of the male, the liver, spleen and kidneys of the fish were examined and tumor nodules of varying sizes were found, similar also to those found by Prof. Stolk in *Nothobranchius guentheri* (see figures 5, 6 and 7). Although the female showed no external signs of erythrophoromas, she also died soon after the male. Subsequent examination disclosed the same nodules present on her kidneys, spleen, and liver. Treatment was to no avail



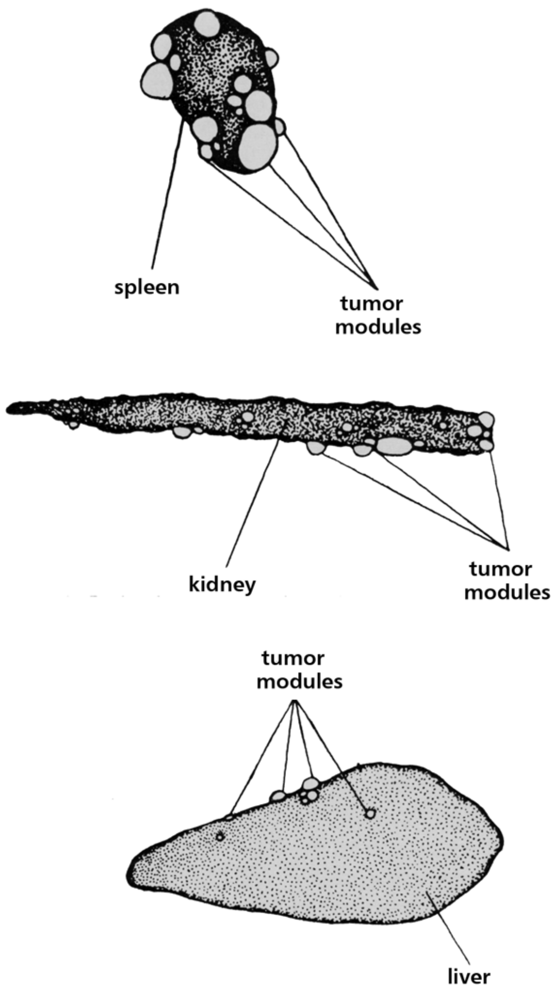
TOP: Figure 1- Erythrophoroma behind dorsal fin of *Nothobranchius guentheri*. BOTTOM: Figure 2 - Other side of fish showing Erythrophoromas on middle of body.





TOP: Figure 3 - Enlargement of Erythrophoromas on dorsal surface of *Nothobranchius guentheri* . BOTTOM: Figure 4 - Further enlargement of tumor nodule (both figures after Stolk).

(salt was used at first under the impression that merely an open wound was involved) and both fishes wasted away quickly.



TOP: Figure 5 - Erythrophoromas on spleen of *Nothobranchius guentheri*. MIDDLE: Figure 6 - Erythrophoromas on kidney of *Nothobranchius guentheri*. BOTTOM: Figure 7 - Erythrophoromas on liver of *Nothobranchius guentheri* (all figures after Stolk).

In a platy-swordtail cross, Gordon described the genetics of a mixed pigment cell tumor involving red and black pigments (an "erythromelanoma"). Both killifishes involved, *Nothobranchius orthonotus* and *N. guentheri,* have been inbred in aquaria to a considerable extent so the distinct possibility exists that aquarium strains of *Nothobranchius,* since such fishes are rich in red pigments, consequently suffer from a genetic weakness resulting in erythorophroma. If this be the case, little chance exists for curing afflicted fishes.

Interestingly enough, tumors of the thyroid gland are not rare in killifishes and I have seen such tumors widespread among populations of *Epiplatys chaperi,* for example. Jacques Lambert (Belgium) found a thyroid tumor in a specimen of *Micropanchax hutereaui* I sent to him for examination and I take pleasure in quoting from one of his letters:

"By the way, the growth under the lower jaw in *Micropanchax hutereaui* which you mentioned may have been a thyroid tumor. *Micropanchax* and other cyprinodonts are sensitive to them. They can, however, be easily checked (and cured, if you don't wait too long) by adding traces of iodine to the water. (A few drops of an iodine-potassium iodide solution will do the job nicely). One generally thinks that traces of iodine are present when one adds a "pinch of salt," but this is only certain if one uses unrefined sea salt. Refined salt (if it does not specifically state that it has added iodine) and many unrefined types of rock salt do not contain iodine."

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The Glass Barbs of The Genus *Chela*

[Tropicals Magazine, May-June 1964]

The subfamily Abramidinae of the family Cyprinidae (carps, minnows, loathes, etc.) contains at least 24 genera of fishes, several of which have been imported for use as aquarium fishes, notably *Chela* and *Oxygaster.* Following the example set by popular use of the term "flying barbs" for fishes of the genus *Esomus.* I have termed fishes *in Chela, Oxygaster,* and related genera as "glass barbs" due to their great transparency. Glass barbs, although usually never imported in great numbers, are found in shipments from abroad in limited quantities on a fairly regular basis. However, the available aquarium reference books allot these fishes little or no space and consequently, hobbyists are at a loss to identify them. No] is this really an easy thing to do, for example, Hamilton-Buchanan created the genus *Chela* in 1822 but it has subsequently been learned that at least four different genera were included among the fishes he placed in that genus! Furthermore, the color patterns of adults and young fishes differ, further adding doubt to any identification. It is the purpose of this article to "break the ice", so to speak, on these identification problems.

The genus *Chela* is in a far better position than its close relative *Oxygaster so* far as classification is concerned. Because the majority of glass barbs imported for use as aquarium fishes belong to the genus *Chela* (pronounced **KEE**'LA), we will discuss only that genus here. A major difference between the two genera is that in *Oxygaster,* the lateral line curves abruptly downward over the pectoral fin while in *Chela,* it curves downwards gently. By careful observation, the aquarist will be able to see the lateral line on his fish and make a decision as to which genus it belongs should the question arise.

When alive, fishes of the genus *Chela* are more or less transparent (although they often have color sheens due to iridescence) but under oblique lighting, they exhibit definite and characteristic color patterns. These will be discussed in detail a bit later. They are small in size (less than 3 inches in standard length, i.e., less tail) and in nature, they are found frequently in streams and in ponds. Their body is almost always strongly compressed, deep or moderately so, and their ventral edge is partly or almost wholly knife-like. Further characteristics include a small mouth, directed obliquely or almost vertically upwards, large eyes, and absence of barbels. They are distributed throughout Ceylon, India, Pakistan, Burma, Thailand, Malaya, and Sumatra but we shall shortly take a more detailed look at more specific distributions.

In the wild, *Chela* provides larvicidal fishes, destroying undesirable mosquito larva, for example. They are not as useful for this sort of work as killifishes but they do a fair job. They are also used as bait for fishes such as the snakehead *(Ophicephalus).* Local villagers also use *Chela, Rasbora, Oxygaster* and similar fishes for food, frying them in large quantity. They are said to be extremely tasty!

The glass barbs, typical surface feeders, are excellent community tank fishes. In India, for example, *Chela laubuca, C. cachius* and C. *dadyburjori* are all commonly reared as aquarium fishes, at least the first two also having been bred in the aquarium there and elsewhere. Briefly, they scatter their heavier-than-water

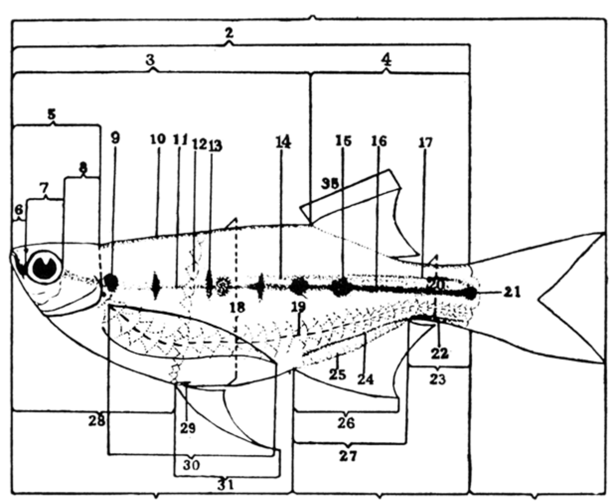


Figure 1: Identifying features of *Chela* species.

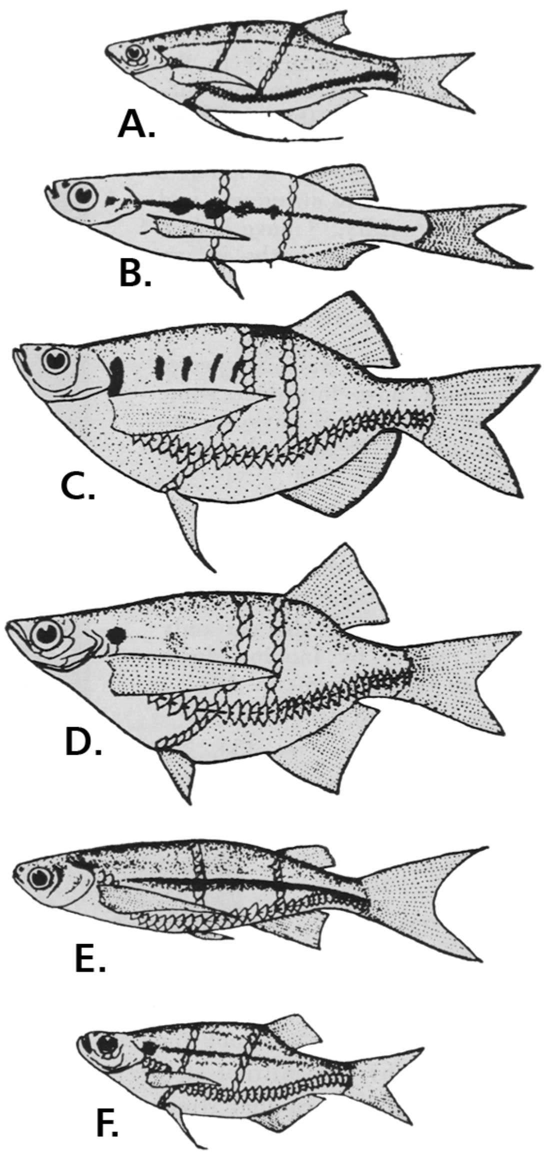


Figure 2: Six *Chela* species:
A. *Chela (Chela) cachius*
B. *Chela (Neochela) dadyburjori*
C. *Chela (Chela) caeruleostigmata*
D. *Chela (Chela) mouhoti*
E. *Chela (Allochela) maassi*
F. *Chela (Chela) laubuca*

eggs as do many rasboras. These eggs are very small and they hatch within 24 hours at temperatures in the neighborhood of 80°F. In some species, the fry struggle to the surface and attach themselves to this surface by a very thin mucus thread. There they hang, about 1/8 inch below the surface, to become free-swimming in about 2 to 3 days. They are lively swimmers and eat even dry foods avidly. I have kept a number of species of glass barbs in my own aquaria and have never failed to be pleased at their beauty, grace and good nature.

In order to identify the various species of *Chela,* we must now introduce some specialized terms. For this purpose, we shall use some of the features shown in Figure 1 as follows:

(a) dark mid-lateral stripe (no. 16)
(b) superficial lateral stripe … situated to the rear of the body, above the mid-lateral stripe (no. 17)
(c) mid-dorsal stripe . . . this can only be seen readily by looking down on the fish from above (no. 10)
(d) shoulder spot (no. 9)
(e) dark vertical stripes (no. 13)
(f) circular spots . . . along the mid-lateral stripe, near the rear of the fish (no. 15)
(g) pre-tail spot (no. 21)
(h) sub-tailroot stripe (no. 22)
(i) supra-anal streak … row of pigment spots parallel to the base of the anal fin, below the lateral line (no. 24)

These definitions will simplify the identification of *Chela* species considerably.

There are 7 species of *Chela,* broken down into 3 subgenera. We now will examine each in turn. The numbers in parenthesis after each fish's name refer to the date of original description.

SUBGENUS I: *Chela*
Four fishes are included in this subgenus, viz., *cachius* (1822), *laubuca (1822), caeruleostigmata* (1931) and *mouhoti* (1945). By referring to Figure *2,* the reader will easily be able to distinguish among them (Note: Figure 2 shows only a partial scalation on each fish). *Chela cachius* (Figure 2a) has much smaller scales

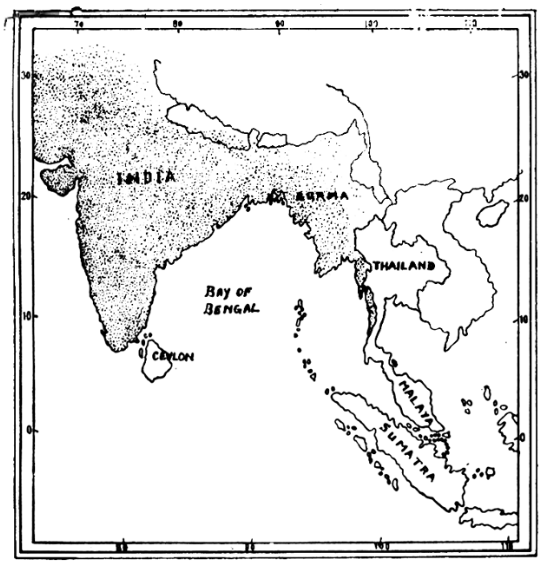


Figure 3: General Distribution of *Chela cachius.*

than the others of the genus. It has a high, dark midlateral stripe, a mid-dorsal stripe, a very faint superficial lateral stripe and is one of the slimmer members of the genus. Figure 3 shows that it enjoys a broad range in nature.

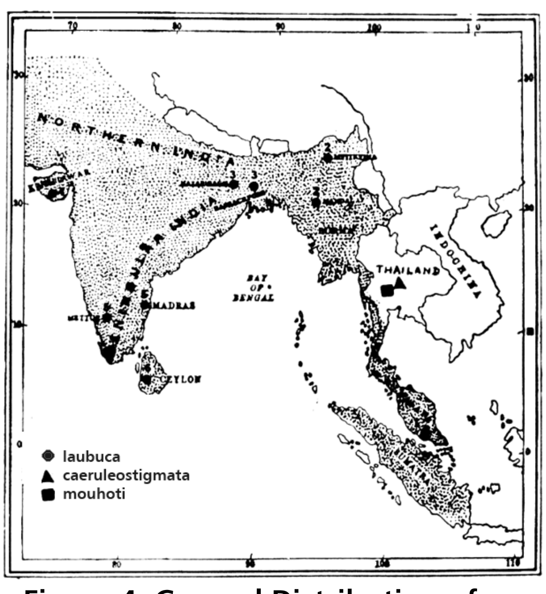


Figure 4: General Distribution of Three *Chela* species:
Dotted - *laubuca*
Squares - *caeruleostigmata*
Triangles - *mouhoti*

Chela laubuca (Figure 2f) is similar in shape but in addition to a dark mid-lateral stripe, it also has a shoulder spot, a mid-dorsal stripe and a pre-tail spot. According to the region of origin, the pre-tail spot and the supra-anal streak may be faint or non-existent … it is a somewhat variable fish (as might be expected from its wide distribution). Bear in mind, however, that all of these markings are generally visible only under oblique lighting and that we are speaking of adults only. In addition, the ventral fins of *laubuca* are shorter than those of *cachius.* The distribution of *laubuca* (Figure 4) *is* even broader than that of *cachius* and Figures 3 and 4 make it clear why Indian aquarists commonly keep these fishes in aquaria … they are simply very easily obtainable. At this point it should be mentioned that the genus *Laubuca is* a synonym for *Chela (Laubuca* was established by Bleeker in 1860) because in old aquarium reference books, the fish is listed as *"Laubuca laubuca".*

The next two species in this subgenus are the "fatties" of the genus! Although both *caeruleostigmata* and *mouhoti* have shoulder spots, only *caeruleostigmata* has dark, vertical stripes (see Figures 2c and 2d). These two species are restricted to Thailand (see Figure 4) and to the author's knowledge, only *caeruleostigmata* has been imported in numbers as an aquarium fish.

SUBGENUS II: *Allochela*

Here we have two species, *fasciata* (1958) and *maassi* (1912) , both relatively slim fishes. In addition, both species possess a dark, mid-lateral stripe and a mid-dorsal stripe (see Figures 2e and 5). However, only *fasciata* has the sub-tailroot stripe and supra-anal streak. On the other hand, *maassi* has a relatively enormous tailfin and a pre-tail spot. In nature, they are far separated, *fasciata* appearing in south-eastern India, *maassi* being found only in Sumatra (Figure 6). To my knowledge, neither has been imported on any appreciable scale.

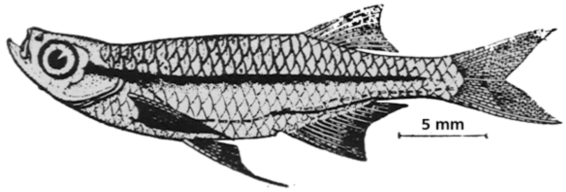


Figure 5: ***Chela fasciata*****.**

SUBGENUS III: *Neochela*

This subgenus contains but a single species, viz., (see Figure 2b) *dadyburjori* (incorrectly spelled as *"dadiburjori").* It not only has been imported a number of times (it was described in 1952), but it is a common aquarium fish in India. This fish has a dark, mid-lateral line plus circular spots (it also has a mid-dorsal stripe). Oddly enough, the lateral line in this fish is either incomplete or absent, in contrast to other *Chela* species. Its distribution is also southeastern India (Figure 6) but it is somewhat more common than *Chela fasciata.*

The above discussion should enable the hobbyist to properly identify any of the species of glass barbs of the genus *Chela.* They are most excellent aquarium fishes and properly deserve a place in any community aquarium.

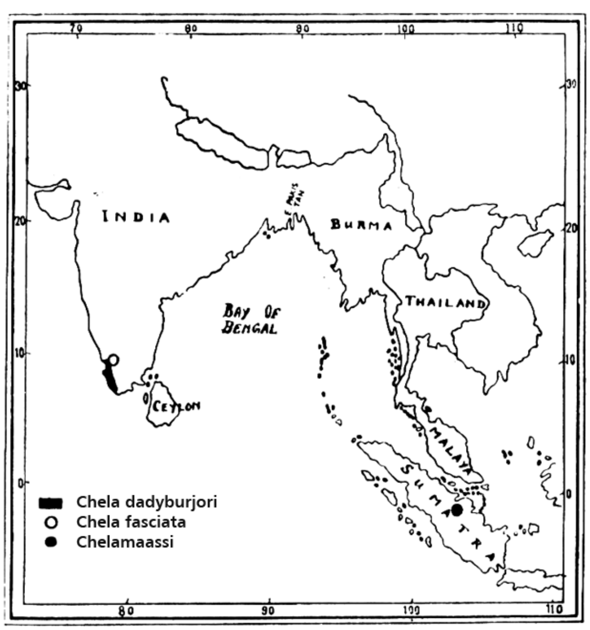


Figure 6: General Distribution of Three *Chela* species:
Dotted - *dadyburjori*
Squares - *fasciata*
Triangles - *maassi*

REFERENCE

Silas, E.G., "Studies on Cyprinid Fishes of the Oriental genus *Chela* Hamilton", *Journal of the Bombay Natural History Society*, Vol. 55, No. 1, pp. 54-99, April 1958.

Catfishes Of The Family Callichthyidae

[Tropicals Magazine, July-August 1964]

A request made by a reader of TROPICALS (which appeared in its "Letters to the Editor" column) some time ago for information concerning the armored catfishes of the genera *Callichthys* and *Hoplosternum,* did not pass by unnoticed. As a matter of fact, it opened up the possibility for a general discussion of the entire family, a discussion that has long been overdue. Except for *Corydoras* (which contains, at this writing, 61 species!), the remainder of the genera within the family are small, permitting a complete review of all of their species in this article. It is hoped that this review will provide aquarists with a satisfactory, overall picture of this interesting family. Since many of the scientific names encountered within the family are real "jawbreakers," I have endeavored to provide phonetic pronunciations when needed. Also, sketches of many of the species described are provided so that the aquarist will have a better picture of just what may be encountered as he follows the many diverse species of the family.

The Callichthyidae (pronounced, KAL-LICK-**THYE'**-AH-DEE) are distinguished externally from all other catfishes by the presence of two longitudinal rows of plates (not scales) completely covering the sides, and by a pair of barbels originating at the junction of the lips at either end of the mouth. They boast quite wide a distribution in nature; north to south from Panama to the La Plata in South America; and

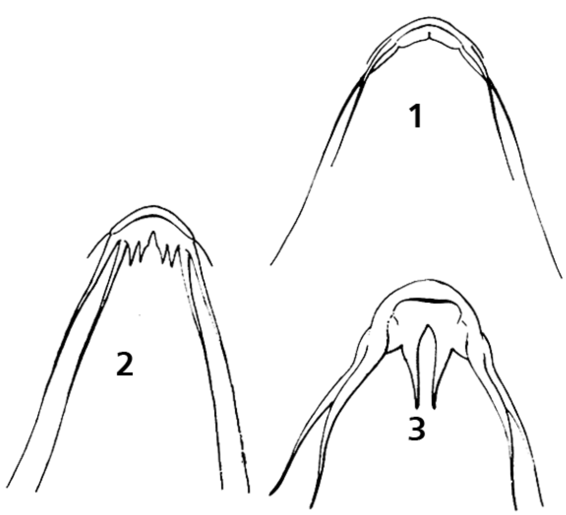
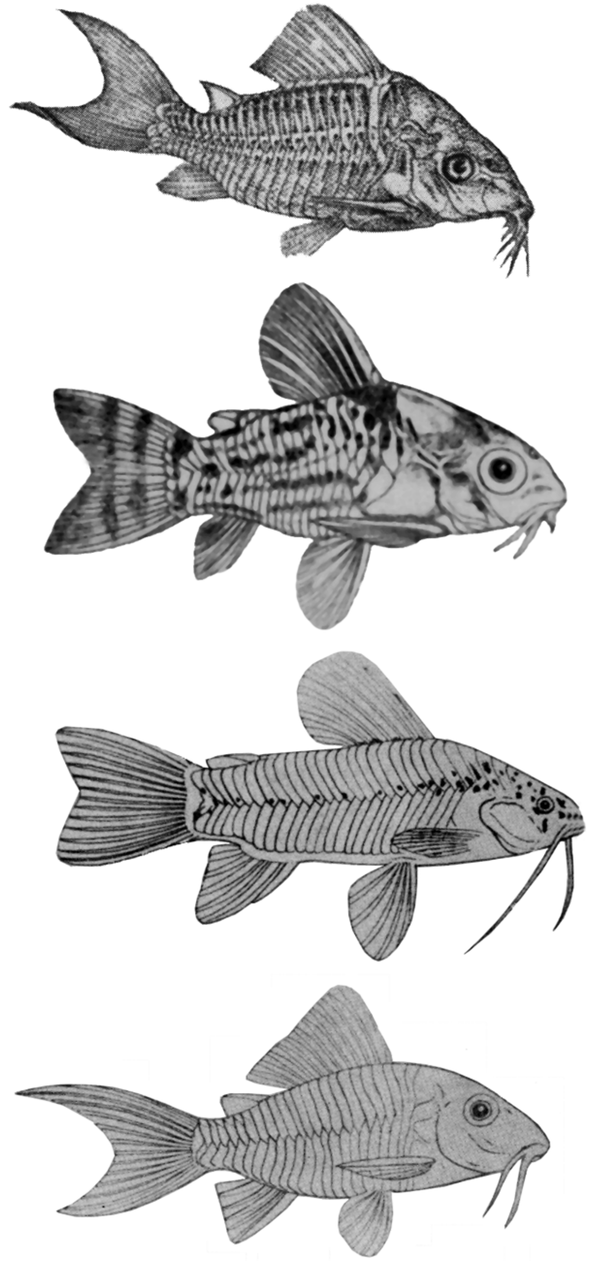


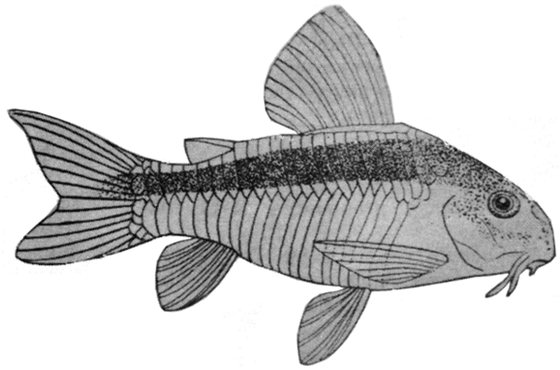
FIGURE 1:
(1) Mouth and barbels of Group I Callichthyids
(2) Same of Group II fishes.
(3) Same of Group III fishes.

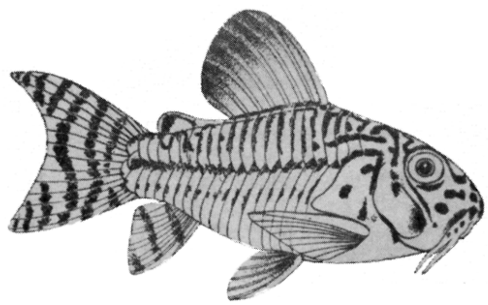
east to west from the Atlantic coast to the Andes. Of the eight genera known, at least five have been imported for use as aquarium fishes and very satisfactory aquarium fishes they have made, indeed. Of these five genera, four have been bred in the aquarium, the number of species having been bred, of course, far exceeding this number. It can be said that aquarists have succeeded more with this family than with any other family of catfishes. Perhaps this explains the deep interest on the part of hobbyists. This article will not be concerned with keeping or breeding, however, but strictly with their classification and identification.

The external characteristics of the genera within the family are shown in Table I. Note that these eight genera can he broken up into three groups on the basis of barbel characteristics (Figure 1). Thus, in Group I we have *Callichthys, Cascadura* and *Hoplosternum;* in Group II we have *Cataphractops* and *Dianema;* in Group III we have *Aspidoras, Brochis* and *Corydoras.* Presently, it is thought that Group II catfishes originated from Group I at some time in the deep past. The classification I have used here is a "lumper's" classification, i.e., a number of ichthyologists in the past have endlessly split these genera far beyond the eight listed, but there seems little sense to this practice now.



FROM TOP TO BOTTOM:
Brochis coeruleus
Corydoras caquetae
Cascadura maculocephala
Brochis eigenmanni
(after Fowler)





TOP :Corydoras zigatus
BOTTOM*: Corydoras episcopi*
(after Fowler)

CATFISHES OF GROUP I

A. *Callichthys* (pronounced, KAL-**LICK'**-THISS)

This genus dates back from 1777 and contains but a single species, *Callichthys callichthys,* first described in 1758 by Linnaeus himself. It is the most wide-ranging of all of the Callichthyidae, being found from Trinidad in the north to Buenos Aires in the south, and from the Upper Amazon and Paraguay systems to the coastal streams of Brazil. As might be expected from its wide distribution, subspecies are known. Since it has a round tail, it is easily confused with *Hoplosternum thoracatum,* some of whose forms also have more or less rounded tails.

B. *Hoplosternum* (pronounced, HOP-LOW-**STERN'**-NUM).

This genus dates back from 1858 and contains but two species, *Hoplosternum littorale* (pronounced, LIT-TOR-**RAY'**-LEE) and *H. thoracatum* (pronounced, THOR-AH-**KAY'**-TUM). Both are extremely variable species

TABLE 1
CHARACTERISTICS OF THE GENERA OF CALLICHTHYIDAE

	Genus	Head Form	Form of Tail	Lower Lip	Placement of Eye	*Lower Lip Barbels*	*No. of Dorsal Rays*
GROUP I	*Callichthys*	flat	round	With fleshy flaps	superior	long	7-8
	Hoplosternum	depressed	Round or forked	"	"	"	7-8
	Cascadura	"	forked	?	"	"	8
GROUP II	*Dianema*	"	"	With 2-4 pairs of barbels	lateral	"	7-8
	Cataphractops	"	"	?	"	"	7
GROUP III	*Aspidoras*	compressed	"	With one pair of barbels	superior	short	7
	Corydoras	"	"	"	"	"	7-8
	Brochis	"	"	"	"	"	10-12

and therefore, subspecies have been described. *Hoplosternum littorale* was described in 1828 and it is distributed from Trinidad to Rio de Janeiro, but is absent from the coastal streams of Brazil. Synonyms for this fish include *H. "schreineri"* and *H. "shirui."*

The second species, *H. thoracatum, was* described in 1840. Here, two subspecies are of interest. The first, *H. thoracatum thoracatum,* is found from the Orinoco to the Upper Paraguay River, and along the east coast as far as Pernambuco. Synonyms for this subspecies include *H. "pectoralis"* and *H. "orinocoi."* The second subspecies is *H. thoracatum magdalenae* (pronounced, MAG-DAH-**LEE'**-NEE) and is found in the area between Panama on the west and the Magdalena drainage on the east, a much more restricted distribution than its sister subspecies. These two subspecies are mentioned because *H. thoracatum magdalenae* has a more forked tail than *H. thoracatum thoracatum,* the latter being, therefore, more easily confused with *Callichthys callichthys.*
The differences between *H. littorale* and *H. thoracatum* are as follows: In the latter, the body, dorsal fin and tail fin are spotted, with the tail fin rays all being about the same thickness. In the former, the body, dorsal fin, and tail fin are plain, and the outermost tail fin rays are considerably thickened.

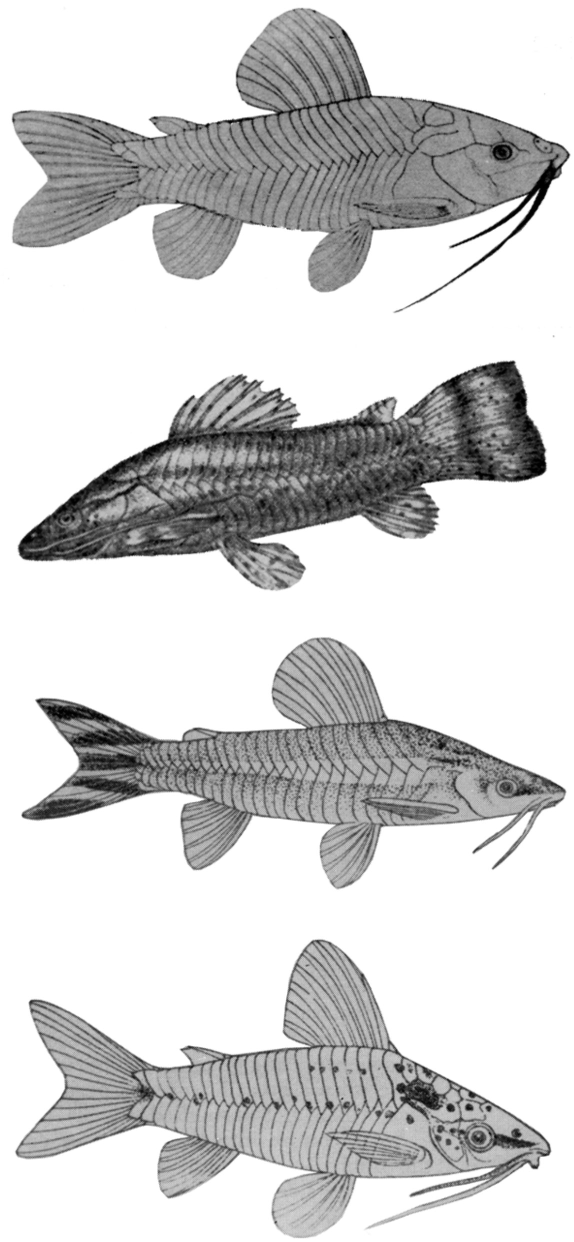
C. *Cascadura* (pronounced,
KAS-KA-**DUR'**-RA)

This genus contains only one species, *Cascadura maculocephala* (pronounced, MA-KEW-LOW-**SEF'**-AH-LA). The species was described in 1913 as coming from Uruguayana on the River Uruguay. Little is known of this species but it is strongly suspected that it is merely the young of a *Hoplosternum* species.

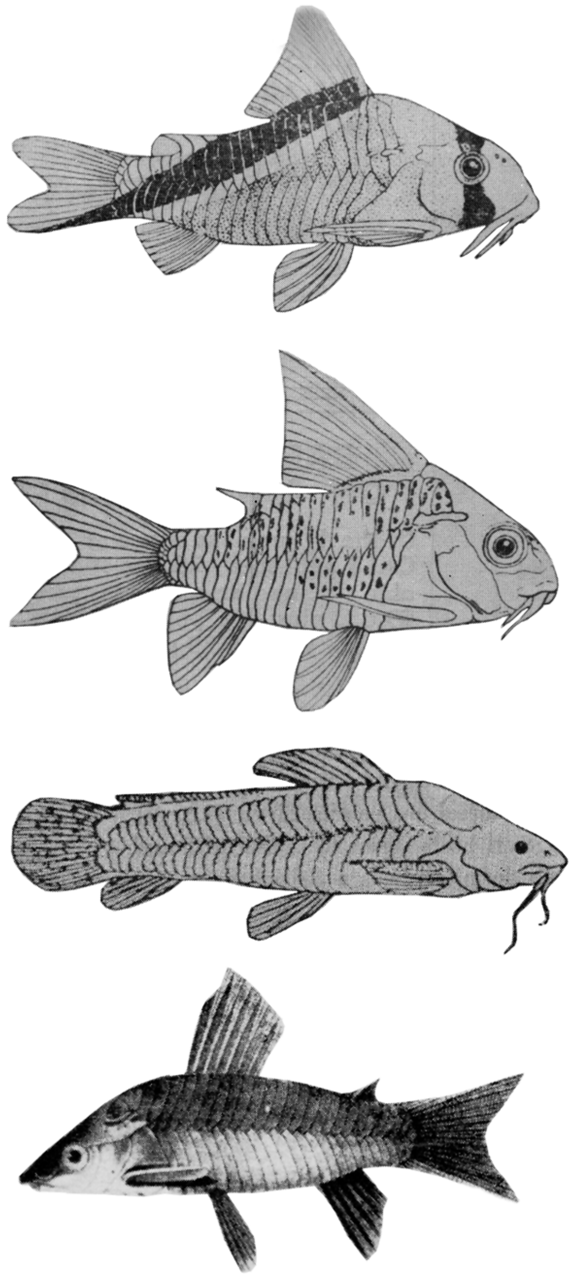
CATFISHES OF GROUP II

A. *Dianema* (pronounced,
DYE-AH-**NEE'**-MA)

A synonym for the genus is *Decapogon, Dianema* being described in 1872 and having priority. There are but two species, *D. longibarbus* (pronounced, LON-JA-**BAR'**-BUS) and *D. urostriata* (pronounced, URO-STRY-**AY'**-TA). *D. longibarbus* has a plain tail, the



FROM TOP TO BOTTOM:
Hoplosternum littorale
Hoplosternum thoracatum
Dianema urostriata
Dianema longibarbus
(after Fowler)



FROM TOP TO BOTTOM:
Corydoras meline
Corydoras armatus
Callichthys callichthys
Cataphractops melampterus
(after Fowler)

tail of *urostriata* having horizontal stripes. Since *longibarbus* is found in the Peruvian drainages, it is commonly imported into this country (as the "porthole catfish"). A synonym for this fish is *Decapogon adspersus*. *Dianema urostriata* is found near Manaos in Brazil.

B. *Cataphractops* (pronounced,
KA-TAH-**FRAC'**-TOPS)
This genus contains only one species, *C. melampterus* (pronounced, MEL-**LAM'**-TER-US), discovered on the Rio Ampiyacu in Peru. The original specimens, described in 1872 under a different generic name, were in a very poor state of preservation (and they haven't gotten any better with time!). Therefore, the genus is doubtful at best.

CATFISHES OF GROUP III

A. *Brochis* (pronounced, **BRO'**-KISS)
This genus, described in 1872, has two species, *B. coeruleus* (pronounced, SEE-**RUE'**-LEE-US) and *B. eigenmanni* (pronounced, **EYE'**-GAN-MANN-EYE). Some differences between these two fishes (see figures for obvious differences) include the fact that *Brochis coeruleus* (which is basically a Peruvian fish) has no naked area in front of its adipose fin while *B. eigenmanni* (found in the Matto Grosso, Brazil) does have a naked area between its scutes (plates) in front of the adipose fin. As a matter of fact, one of the synonyms for *B. eigenmanni* is *"Chaenothorax semiscutatus"* ("*Chaenothorax*" is a synonym for the genus). *Brochis* is similar to *Corydoras* but has more dorsal rays (see Table I).

B. *Aspidoras* (pronounced,
AS-PY-**DOOR'**-AS)
This genus (described in 1907) contains but a single species, *Aspidoras rochai* (pronounced, **ROW'**-KA-EYE), found in northeastern Brazil.

C. Corydoras (pronounced,
CORE-EE-**DOOR'**-US)
Aquarists have seen enough *Corydoras* species so that it would be useless for me to picture any but a few of the rarer kinds. As a matter of interest, however, the following are all the spe-

cies presently considered valid at the time of this writing:

acutus, aeneus, ambiacus, arcuatus, armatus, aurofrenatus, axelrodi, barbatus, bertonii, bondi, brevirostris, caquetae, caudimaculatus, cervinus, cochui, concolor, elegans, ellisae, episcopi, eques, fowleri, funnelli, garbei, grafi, griseus, guapore, habrosus, haraldschultzi, hastatus, julii, talus, leucomelas, longistris, macropterus, melanistius, melanotaenia, melini, metae, micranthus, microcephalus, microps, multimaculatus, myersi, nattereri, paleatus, pestai, polystictus, potaroensis, punctatus, rabauti, raimundi, reticulatus, schultzei, serpentrionalsi, spilurus, stenocephalus, sterbai, sycheri, treitli and *zygatus.* Anyone who would be a *"Corydoras* expert" has his work cut out for him indeed!

Prettiest Fundulus Of Them All?

[Tropicals Magazine, September-October, 1964]
(Note: This article was co-authored with Donald Dickason, AJK being the Senior Author.)

The complaint that aquarists overlook our native fishes, many of which rival imported "exotics" in beauty, is voiced so often that it is fast becoming a cliché. It seems that it is about time we stopped talking about "natives" and started doing something about them. To this end, a group of members of the American Killifish Association have been steadily at work, concentrating on keeping and breeding members of the genus *Fundulus* and to date, have racked up an impressive total of successful encounters with these fishes (a bibliography of articles written by these aquarists is offered at the end of this article … all of these are available currently and are suggested as a starting point for those who would like to try their own hand at keeping and breeding native killies). Within a year, their contribution to our knowledge of this genus has exceeded the sum total of everything written about them in the American aquarium literature in the past. As two who love Nature's creatures be they dubbed with the romanticism of being imported from far off lands, or just gleaned from our own back yards, we would like to add our observations of one more species of *Fundulus* to this continuing study.

Our subject is the plains topminnow, *Fundulus sciadicus* (pronounced SYE-**AY'**-TA-KUS, the term originating from an ancient genus meaning "shade" or "dark fish"). Although there are many species of *Fundulus,* this one does not appear to be very closely linked to any other. We mention this because the genus does contain a number of "species pairs" (i.e., very closely related species as, for example, *F. confluensis* and *F. pulvereus).* It is found (see figure 1) along the Great Plains from South Dakota, Wyoming, and Iowa, southward to northeastern Oklahoma (the Arkansas River system). It is displaced northwest of this area by *Fundulus diaphanus. Fundulus sciadicus* was described by Cope in 1865, and imported into Germany as an aquarium fish in 1931 (from a St. Louis fish breeder!). At that time, it was known to American aquarists as *"Fundulus macdonaldi."*

The coloration of the male (see figure 2) is as follows: Body olive-green dorsally, bluish-green on its sides and pinkish ventrally; scales edged in thin red border on the sides; there are

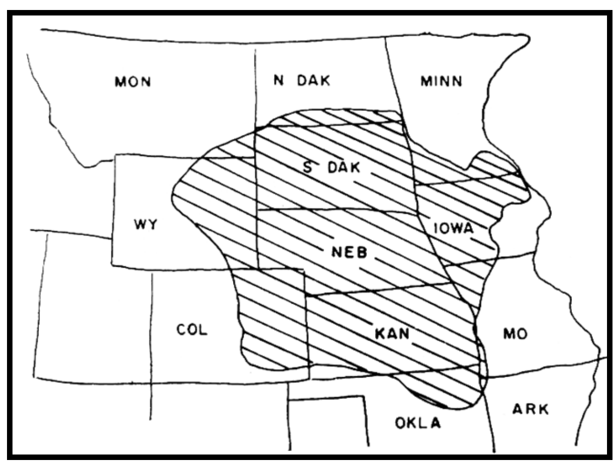


FIGURE 1: Approximate Distribution of *Fundulus sciadicus*.

FIGURE 2: *Fundulus sciadicus*, male above, female below.

large green markings on its gill covers; a dusky longitudinal band (not easily seen in bright light) present on sides. Dorsal fin pale yellow-orange basically, a thin bluish-black line edging the top of the fin, and a broad submarginal band of bright orange-red; very fine black spots cover the pale-yellow portion of this fin. Caudal fin edged in thin bluish-black line, upper, rear, and lower; broad submarginal band all around fin of bright orange-red; center of fin base pale_ yellow-orange; center of fin also filled with very fine black dots near base. Anal fin pale yellow-orange basally, thin bluish-black lower edge; a broad, bright orange-red submarginal band. Ventrals bluish basally, pale orange otherwise. Pectorals colorless. The coloration of the female (see figure 3) is as follows: Brownish dorsally, lower sides pale blue; greenish sheen to gill covers; dusky longitudinal band (not seen in bright light) on sides. All fins colorless to pale yellow (pectorals, however, definitely colorless).

Average length of males in authors' possession 21%4 inches, females 1% inches. When viewed from the top, *Fundulus sciadicus* has a thin, white line extending forward from the dorsal fin to a point about halfway between the leading edge of the dorsal and the head. This has served us in distinguishing *F. sciadicus* from its co-habitants in its natural environment.

Within its range, *F. sciadicus is* typically found in small- to medium-size clear, sandy to rocky streams, in moderate to rapid currents. However, our specimens were found over muddy bottoms and where vegetative cover was present (in the form of filamentous algae, aquatic grasses and also non-aquatic debris such as tumbleweed). Ignoring the tumbleweeds, cottonwoods, jackrabbits, rattlesnakes, magpies, and other non-piscine life in the area, *Fundulus sciadicus is* surrounded by other fishes and is probably never to be found by itself. Trout and other coldwater types will not often be found in company with the plains topminnow, although their habitats adjoin along the base of the displaced northwest of this area by *Fundulus diaphanus. Fundulus sciadicus* was described by Cope in 1865, and imported into Germany as an aquarium fish in 1931 (from a St. Louis fish breeder!). At that time, it was known to American aquarists as *"Fundulus macdonaldi."*

The coloration of the male (see figure 2) is as follows: Body olive-green dorsally, bluish-green on its sides and pinkish ventrally; scales edged in thin red border on the sides; there are large green markings on its gill covers; a dusky longitudinal band (not easily seen in bright light) present on sides. Dorsal fin pale yellow-orange basically, a thin bluish-black line edging the top of the fin, and a broad sub-

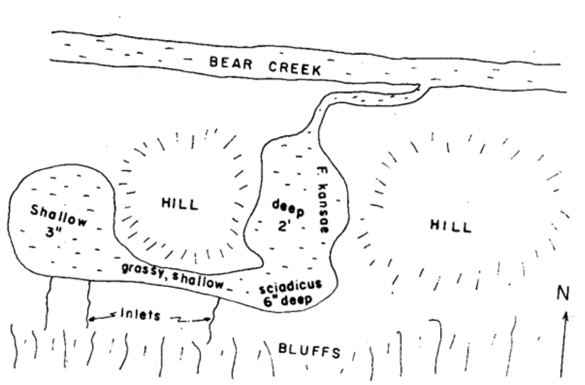


FIGURE 3: Schematic diagram of habitat of *Fundulus sciadicus* where the authors' fishes were discovered.

FIGURE 4: The natural habitat of *Fundulus sciadicus*.

marginal band of bright orange-red; very fine black spots cover the pale-yellow portion of this fin. Caudal fin edged in thin bluish-black line, upper, rear, and lower; broad submarginal band all around fin of bright orange-red; center of fin base pale yellow-orange; center of fin also filled with very fine black dots near base. Anal fin pale yellow-orange basally, thin bluish-black lower edge; a broad, bright orange-red submarginal band. Ventrals bluish basally, pale orange otherwise. Pectorals colorless. The coloration of the female (see figure 3) is as follows: Brownish dorsally, lower sides pale blue; greenish sheen to gill covers; dusky longitudinal band (not seen in bright light) on sides. All fins colorless to pale yellow (pectorals, however, definitely colorless).

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Rockies. Such fish as green, pumpkinseed and orange-spotted sunfishes, brassy minnows *(Hybognathus hankinsoni),* fathead minnows, longnose dace, Plains Mountain suckers and western white suckers, are found with *F. sciadicus.* Central plains killifish *(Fundulus kansae)* seem to be in all the locations in which we have found *F. sciadicus* but the reverse is not true since *F. kansae* also likes gravelly streams devoid of plant life. In Colo-

FIGURE 5: Seining for *Fundulus sciadicus*.

FIGURE 6: Up she goes! The one-man seine in action.

rado, these two *Fundulus* species are the only known native representatives of their family. Some logperches and darters are found with *F. sciadicus* and probably every cool water fish found in its range can, at least occasionally, be found in company with it.

In nature, *F. sciadicus* feeds at the surface but sometimes darts into the bottom sediment to stir out insect larvae.

One of the authors has found F. *sciadicus* in several places near Denver (see figures 4, 5, 6, 7 and 8). A typical location is one particular oxbow pond in the valley of Bear Creek just west of the southern suburbs of Denver. The pond has an area of perhaps 200 square feet and a maximum depth of no more than two feet with underlying mud also about two feet deep. It's not much of a pond but it swarms with fish of most of the species mentioned earlier. It is fed by a trickle of water that runs down the bluff from small lakes higher up. There is a small outlet connecting with Bear Creek. Needless to say, this is a favorite place for small neighborhood boys to catch frogs, crayfish, and minnows. The water in this pond has a pH of 7.6 and a hardness of DH 20.

Bear Creek runs from the vicinity of Mt. Evans to the South Platte, south of Denver. At the point in question, the ecology is definitely that of the high plains. A few miles west of this is the Front Range of the Rocky Mountains that has a strikingly different ecology. Seasonal temperatures in this area range between -10° to 90° F, very rarely higher or lower but in the winter, there are frequently warm days and the ice may melt completely from lakes and streams.

Keeping this killifish poses no problems. We have kept a male *F. sciadicus* in a 20-gallon community aquarium for several weeks. This fish has proven to be a moderately peaceful member of the community. The main exception occurs at feeding time when he sometimes chases one of the three female guppies away from the part of the surface where he is feeding. He has been known to make a pass at an occasional zebra danio or gold tetra and once joined forces with a Firemouth cichlid in chasing a betta.

Usually, this killifish is to be found near the surface in the community tank, but he frequently explores the bottom. He is in motion most of the time. Perhaps he is uncomfortable at 75° F., but it must be kept in mind that his favorite shallow pools frequently become quite tepid under the hot Colorado sun. In nature, insects, larvae, and small crustacea are its usual diet but it can readily be persuaded to eat dry, prepared foods. However, it greedily devours shredded beef heart and adult, frozen brine shrimp.

After receiving a pair of *F. sciadicus* from the other (a matter of shipping from Colorado to Ohio in a very small container!), one of the authors spawned the fish within a week. It appeared so easy that it was concluded that *F.*

sciadicus was a "beginner's fish." This, however, immediately elicited the following remark from the other: "How did you get spawn from the *sciadicus so* soon? I tried it with larger specimens and the male killed three females with his attentions!" A quick check of the German aquarium literature indicated that Germans also considered males to be rough on females. When male killifish are hard on females, certain precautions must be taken. The fish we bred (a single pair at first although both authors managed to breed the fish after awhile) were housed in a bare, 5-gallon aquarium containing an inside filter. The water was moderately hard and kept at 75° F. However, four nylon spawning mops (the circular variety) were used to provide refuge for the female. Unless she was perfectly willing, the male could not catch her. Also, when feeding, food was first dropped near the male, then near the female. In this way, the male did not keep the female from her food. As a result, it was not long before eggs were obtained and contrary to German references, they were obtained in good quantity. No particular preference was shown for level as the eggs were found everywhere on the mops. The eggs were clear, measuring 1.8 mm in diameter (this compares with *F. chrysotus* at 2.0 mm). At 75° F, the first fry hatched out in 8 days, with almost all of the remainder hatching out by the 10th day. There was no need to force the hatching. The fry were large and active, taking brine shrimp nauplii from the start as well as powdered dry food.

FIGURE 7: A typical haul of *Fundulus sciadicus.*

Fundulus sciadicus is an eminently satisfactory aquarium fish. Perhaps it is our most beautiful *Fundulus,* vying with *F. cingulatus* for this honor. It always elicits much praise from visitors to our fishrooms and questions such as, "What fish is that!" We are tempted to say, "Oh, some rare killie from Ceylon," but the true fancier will not let its domestic origin keep him from admiring its great beauty, and evaluating it on its merits alone.

The Characins

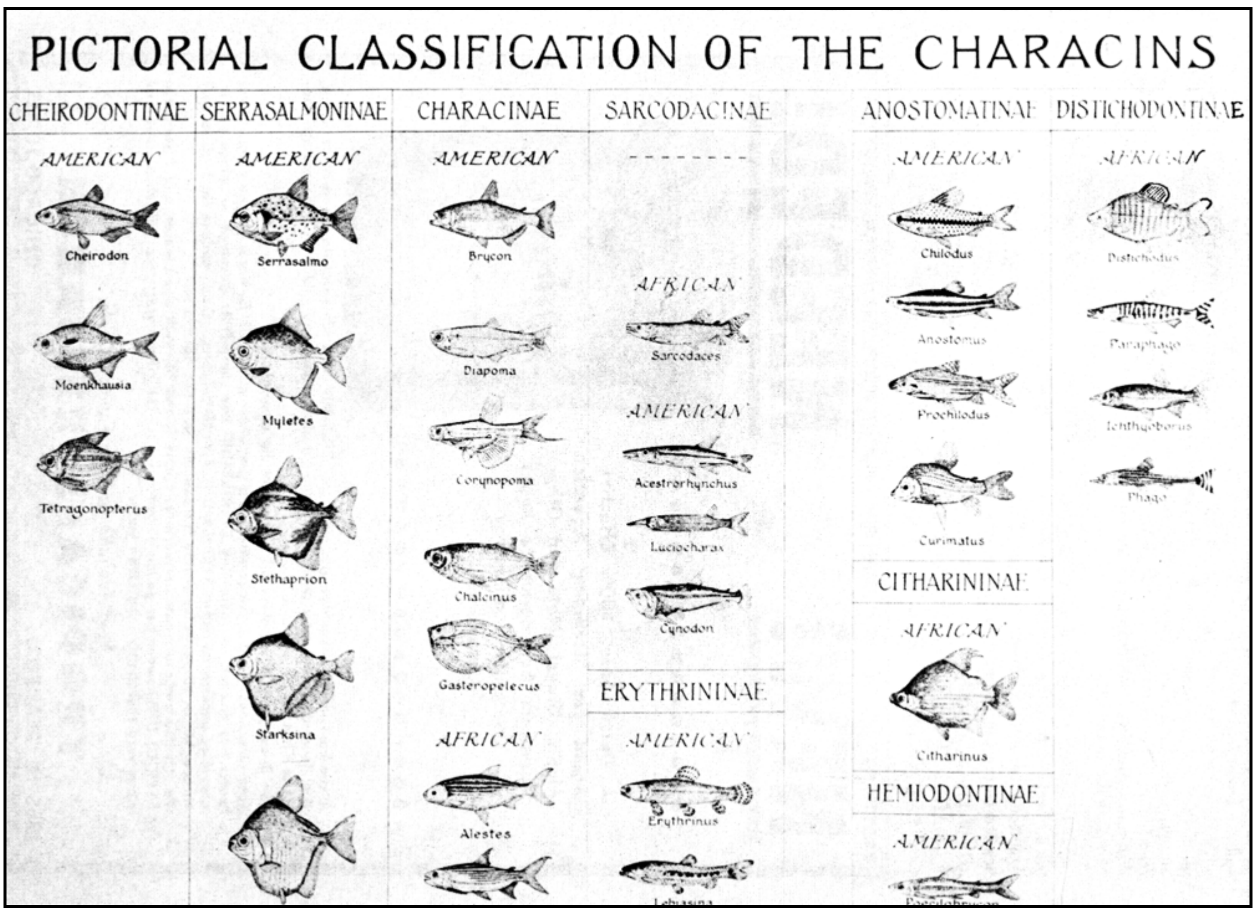
[Tropicals Magazine, November-December 1964]

If we consider the family Characidae and the aquarium fishes it contains, then perforce we look at a very large chunk of the hobby indeed. To aquarists, these are important fishes and it seems that no matter how highly specialized a hobbyist might become, one need only look in his community tank to discover characins. For the most part, these are the bright, lively, small schooling fishes of the aquarium hobby. Yet, it is exceedingly difficult to characterize the characins in but a few words. The deep body, extensive dental equipment and large adipose fin of a silver dollar *(Metynnis),* for example, contrasts quite dramatically to the slender body, minute teeth and tiny (or absent) adipose fin of a Pencilfish *(Poecilobrycon).* It might serve a useful purpose then, to survey this extensive family in order to obtain that "big picture" which puts so many things into its proper perspective in the hobby.

Although there are a number of different classifications of the family Characidae that one might look at (those of Boulenger, Eigenmann and Cockerell, for example), it seems best for our purposes to examine a very concise and relatively recent one (see Figure 1 and also the reference). This classification subdivides the family into nine subfamilies (note how the name of a subfamily ends in -inae). It would be impossible in this article to list all of the genera within each subfamily, even just those that have supplied us with aquarium fishes. Therefore, only a few key genera are illustrated. Imagine what it would be like if we attempted to list all of the species!

A study of the phylogeny of the characins (which is merely a biological history of the family) shows that the key subfamily is Cheirodontinae. It is from this subfamily that we suspect all of the others have their origin. The fishes in this subfamily are primitive, specialized characins with a moderate-to-small mouth. Among its familiar aquarium genera we include *Cheirodon, Moenkhausia* and *Tetragonopterus.* But perhaps the subfamily that supplies more aquarium characins than any other is the Characinae. This subfamily forms the large, central group of African and South American forms arising from the Cheirodontinae (note that there are no characins in Asia). Since it is such a large group, its members vary greatly in body form. Here we find hosts of aquarium genera including *Brycon, Corynopoma, Chalceus, Gasteropelecus,* and *Alestes,* to name but a few.

The Serrasalminae are extremely deep-bodied fishes, representing short, heavy offshoots of the genus *Tetragonopterus.* Here we find our piranhas and silver dollars, i.e., *Serrasalmo, Metynnis, Mylossoma, Colossoma,* etc. A lesser-known subfamily is the Sarcodacinae. These are the predatory "pikes" of the family,



usually with elongated jaws. Not too many aquarists are familiar with members of this subfamily but the author has kept one genus in the aquarium, viz., *Acestrorhynchus*. It is an expensive proposition because they will eat nothing but live fishes!

Another "nasty" subfamily is the Erythrininae from which aquarists obtain their predatory *Erythrinus* and *Hoplias.* These fishes are relatives of *Sarcodaces* but have more or less, broad and rounded heads. Presently, I have both species of the subfamily mentioned, specimens of which I caught in the Peruvian Amazon. A more familiar subfamily is the Anostomatinae, fishes with slender-to-deep bodies but which are herbivorous. They are all American in origin. Here we find fishes such as *Leporinus, Chilodus* (the headstander), *Prochilodus* (the South American flagship) and, of course, *Anostomus.* The African counterpart of the Anostomatinae is the Citharininae for they parallel each other in many respects. A few species of *Citharinus* have been imported as aquarium fishes but it cannot be said that this subfamily provides very many fishes for the aquarist at this time.

Some years ago, American aquarists saw many members of the subfamily Distichodontinae, a strictly African group of fishes. The prime genus for hobbyists in this subfamily is *Distichodus* but not very many are seen nowadays. One subfamily that does provide many aquarium fishes is the Hemiodontinae, consisting of small, spindle-shaped offshoots of the Characinae with short anal fins, tiny or reduced adipose fins and very small teeth. Prime among the aquarium genera here are *Hemiodus, Poecilobrycon,* and *Nannostomus,* the last two being the pencilfishes of the aquarist.

Those who have studied the characins have observed that the African and South American forms are closely related. This has led to the postulation that at one time, a land bridge existed between Brazil and West Africa. However, it did not exist for very long. While we are talking about times past, scientists have observed that characins are wholly absent from the ancient freshwater deposits of North America. Indeed, aquarists know that except for *Astyanax,* no characins are found in the United States today.

Our picture of the family Characidae has been brief but it should serve to relate in the aquarist's mind, the many pleasing forms of these fishes that have contributed so much to our hobby.

Some Genetical Misconceptions

[Tropicals Magazine, March-April 1965]

(Editor's note: The following material was re-printed from ARES REPORTS, Dec. 1964).

Mendelian genetics is a vast oversimplification of the real world. Consequently, this "beanbag" is in many ways quite misleading. We have aquarists thinking that deltatail is encapsulated in some deltatail gene or that black body is boxed into some black body gene. It is naive to regard a gene as a mold into which a character is poured. There is no such mold, for example, for the dorsal fin of a betta. What is overlooked is that genes merely give the potentiality to produce or to contribute to the production of a physical character, all other things being equal. These "other things" include the external as well as genetical environment. Let us begin with the genetical environment first.

The capacity of a gene to affect several different areas in the physical aspect of an animal is called "pleiotropy." In short, pleiotropy is a synonym for multiple gene effects. Many of the genes for color in fishes, for example, appear to have an effect on body size. More important, however, is the fact that pleiotropy often affects the very characters that are of the greatest interest to aquarists, e.g., fertility, sexual vigor, longevity and tolerance to environmental extremes. The phenomenon of pleiotropy is now so well substantiated that geneticists are beginning to wonder whether any genes exist, in higher organisms such as fishes, that are not pleiotropic.

An example of a pleiotropic gene is the C_p gene in the guppy. This is a gene linked to the X-chromosome and primarily manifests itself in a form of black pigmentation in the caudal fin. But in addition to caudal pigmentation, it affects the shape of the tail as well. It is a vital in gradient in the formation of deltatail fish.

Characters may be continuous or discontinuous. Size is a continuous character; the fact that a fish has a tailfin or hasn't, is a discontinuous character. Although discontinuous genetic differences may obey Mendel's Laws, continuous ones do not. The explanation lies in the fact that a character may be affected by the product of many genes. This is called "polygeny" or simply, "multifactional inheritance." For example, in the goldfish we find two basic physical forms known as "metallic" and "matte." The former is a highly reflective type produced by the presence of guanine crystals in the skin The latter represents the absence of such crystals, producing a dull appearance Combinations of metallic and matte are known as "nacreous". The greater the area of the fish containing guanine, the greater the metallic area. Goldfish are found in all states from 0% metallic to 100% metallic but there is no gene for, say, 75% metallic. The fact again is that there are a number of genes that contribute to the presence of guanine in the goldfish and each one contributes to the total amount. This makes for a wide variability in the physical appearance of goldfish.

This does not mean, however, that continuous characters are always determined by a large number of genes each with a very small effect. There are always a few genes that make the major contribution. The fewer these major genes and the larger their individual contributions, the more discontinuous the inheritance will be.

For example, in the guppy, deltatail is determined by many genes but only two of them are individually of great consequence, i.e., C_p (linked to the X-chromosome) and D_s (linked to the Y-chromosome).

Finally, the genetic environment does not determine all. Aquarists know full well, for instance, that size in fish is partly controlled by the external environment and type of care given. We may "runt" our fishes quite at will. But what many aquarists do not know is that many characters they ordinarily consider to be controlled strictly by genes are not so controlled at all. The fact that a male livebearer, for example, has a gonopodium is not due to the fact that the male carries a "male" or Y-chromosome where the female does not. We can, by way of illustration, produce a gonopodium on a female livebearer by the use of hormones. Contrary to what some aquarists believe, genetic characteristics are not affected by hormones, changing water, feeding, etc. What is overlooked is that genes contribute only a potentiality for the particular development of a physical character. To be sure, genes are necessary factors but the point is that they are not sufficient ones.

If we, as aquarists, shackle ourselves to classical Mendelian genetics, then surely we shall "miss the boat" in improving our fishes. We shall be reduced to ridiculous notions such as the inheritance of veiltail in the guppy is analogous with that of the inheritance of color in sweet peas. I would rather stick with the classical "seat-of-the pants" breeding of the old-timers than to embrace this sort of pseudo genetics. These old-timers knew or cared little of genetics but they never the less developed fantastic strains of fishes in the hobby. They did this by applying themselves to the environment of their fishes with great patience and skill. We now know that there was an "invisible" factor that permitted much of their success, however. This mystery factor lies in the field of non-Mendelian genetics and it is simply that each and every one of our fishes contains a vast "pool" which is both flexible and vigorous. A statistical study of genetics reveals that due to this genetic pool and its characteristics, deliberate selection by aquarists often produces results in an amazingly short period of time. One readily visible example of this is the tremendous number of advanced forms produced by the breeders of fancy livebearers (Simpson swords, high fin moons, fancy guppies, etc.) within a relatively short period of time.

How To Write An Impressive Fish Article

[Tropicals Magazine, March-April 1965]

The editor of *Tropicals* has had a number of inquiries as to exactly how one goes about writing an article for an aquarium magazine, or more to the point, how one writes an article having a high probability of acceptance by editors. Fortunately, the alleged difficulties encountered in writing an impressive fish article can easily be overcome if the fledgling author merely observes a few rules and the unbeatable outline that follows.

The first item of business in writing an article is choice of subject. Along the years, certain topics have become standbys in the hobby as, for example, the breeding of zebra danios. Surprisingly, hardly a month goes by without some hobbyist demanding information on this subject. Judging by the number of such letters received by aquarium magazines, the breeding of zebra danios is the best-kept secret in the hobby. Let us, for purposes of exposition, however, assume that you have selected this subject for your article. Then the next item on the agenda is a title.

The problem with a title such as "Breeding The Zebra Danio," is that it just doesn't impress anyone. Even the dyed-in-the-wool guppy fancier, who might be under the impression that the zebra danio is a livebearer, would not be impressed by this rather forthright beginning. A far better title would be, "Fertility, Caudal Temperature and Plutonium Uptake of the Asian Cyprinid, *Brachydanio rerio."* Now do not misunderstand me. Even with this title, hardly anyone is going to read your article but it will be dutifully clipped out and saved for future reference. Articles with impressive titles are always clipped out and saved for future reference.

There are, however, a few hobbyists who do read fish articles. These people will read anything, including the list of ingredients on the label of a distilled water bottle, so you must be prepared to deal with them. A good way to begin your article is with a few facts. One might observe, for example, that the zebra danio was named in 1873 by the famous Israeli ichthyologist, Shadrach. An aside on the date seems to further heighten interest such as, "It was hot that year." At this point, the reader is totally on your side for rather than admit that he has never heard of Shadrach he will nod knowingly and say, "Yes, Shadrach certainly outdid himself in 1873".

The goal of the author is to force the reader to ultimately give up and concede his defeat. There are a number of approved ways of doing this. One way, for example, is to continually switch terminology without warning, e.g., use "caudal" and "tail" fin interchangeably. This throws the reader entirely off the track and makes him easy prey for one of the oldest tricks in the book, viz., the use of a random asterisk. When a reader sees an asterisk, he immediately recognizes it as the standard symbol for a footnote and starts to look for one. The most effective place to utilize the random asterisk is right after a statement which obviously requires clarification, e.g., "These five discus were easily sexed by the use of Warburton's Technique*". Readers will frantically search for days for the missing footnote.

There are a number of key phrases that should be mastered by every author. The most valuable among them is, "It is obvious …", and an example would be: "It is obvious that in light of Applezweig's Law, the progeny of a cross between a red, three-quarters black male guppy and a albino female, would result in 63% green delta tails, 28% polka dot males and 9% striped females". This device is especially effective should the percentages add up to a number other than 100. No self-respecting reader would dare take issue with any statement that began, "It is obvious …" Our example also provides us with a double-barreled opportunity to throw the reader into utter and abject frustration. Notice that we have referred to "Applezweig's Law." Suppose we have added, "(see bibliography)", immediately after this. Two courses would then be open to us. The simplest would be to omit any bibliography whatsoever. A more diabolical device, however, would be to list the references but to relegate it to a source guaranteed unobtainable such as the PEKING QUARTERLY FOR PSYCHOCERAMICS.

There is, of course, a right and wrong way to describe your experiences. We do not condone outright lying and certainly encourage all authors to be as truthful as possible. But there are, shall we say, certain liberties that are permissible. Suppose, for example, you dipped your finger into the aquarium to see if it was too warm or too cold for your fish. Refer to this as an "experiment." It also helps to give the experiment a number. For example, "Experiment number 18 was to determine the water temperature in ambient surroundings." Do not mention your finger at all. Notice that we have used another effective device in the phrase, "ambient surroundings." The word "ambient" means "all around." as does the word "surroundings." This is known technically as a "tautology," i.e., a needless repetition, and its value lies mostly in the fact that authors frequently get paid on a per word basis. Effective use of tautologies may increase the fee earned for an article to 50% or more.

Illustrations do wonders for any article. An effective gambit for a zebra danio article is to show an unlabeled photograph of a spotted danio. Readers go paranoiac trying to equate your written description with the photo. A device similar to the random asterisk is the random chart. This is a chart that reads somewhat as follows: "Factor A - 12.5 grams, Factor B - 3.2 grams. Factor C - 17.1 grams, etc.". The reader, upon completion of the article, fails to recall that such a chart was mentioned at all in the text and suspects that he skipped a page or two. He then is forced to re-examine the entire article, looking for a reference to the chart. If one feels absolutely compelled to refer to one's illustrations, one can always discuss the "blue" line on the graph, and the "red" one, etc., knowing full well that the graph will be printed entirely in black and white. The use of this technique has sent more than one reader to the optometrist for a color-blindness check.

Closing paragraphs are quite critical. The standard of course is to complain bitterly that your fish is overlooked by most aquarists, hard-to-find in the stores, and fast being pushed aside by more exotic forms such as lyretail knifefish. If you are writing about the zebra danio, this will not be an easy job but it can be done. How to write an impressive fish article? Let me quote from Gilbert and Sullivan's operetta, "Patience":

"If you're anxious for to shine in the high
aesthetic line as a man of culture rare,
You must get up all the germs of the
transcendental terms, and plant
them everywhere,

You must lie among the daisies and discourse
in novel phrases of your complicated state of
mind,

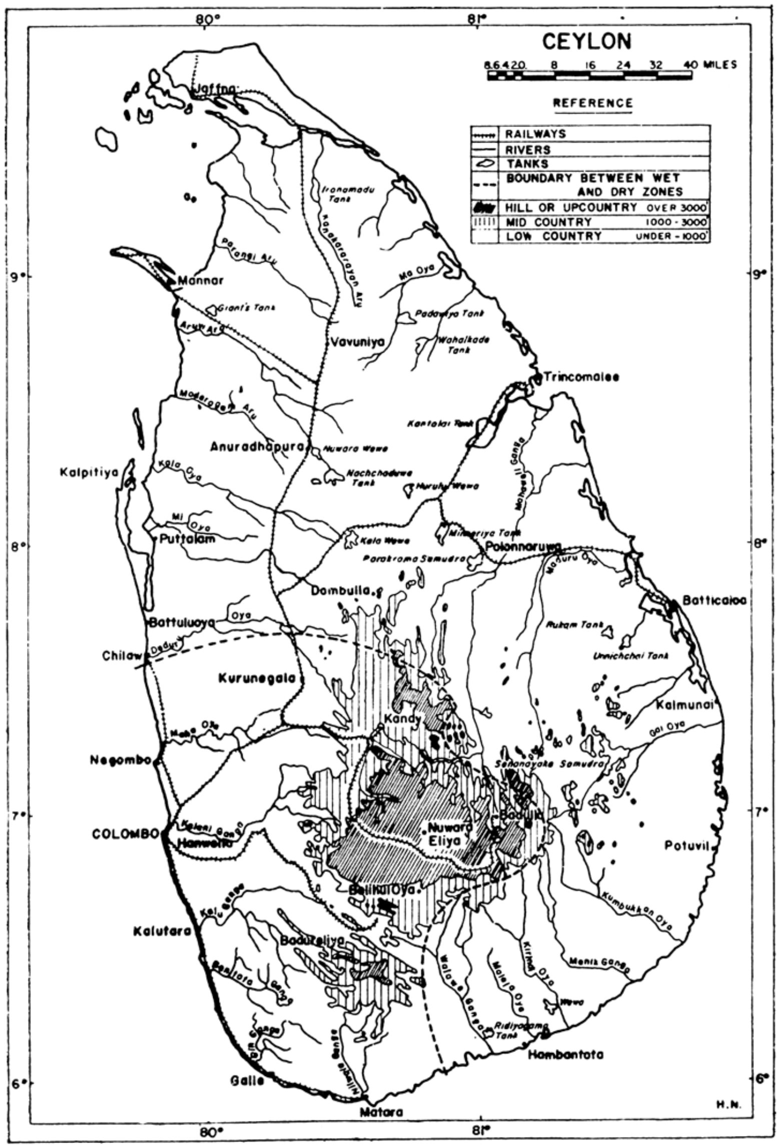
The meaning doesn't matter if it's only idle
chatter of a transcendental kind."

Aquarium Fishes Of Ceylon - Part 1

[Tropicals Magazine, November-December 1963,]

A. INTRODUCTION

As might be expected, the freshwater fauna of Ceylon is closely related to that of its neighbor, India. However, because of its geographical isolation from India (albeit recent in the geologist's scheme of reckoning time), some tendency towards subspeciation has occurred. This aspect will not be covered in this article (a discussion of this problem is planned for some future date); instead, a general survey of the sixty-odd species of freshwater fishes of Ceylon is planned, much in the manner of the author's previous article on Bornean fishes (see Tropicals, Vol. VII, No. 5, "Aquarium Fishes From The Mysterious Island", pgs. 14-17). This is in line with the writer's long-range program of presenting such surveys to the hobby in order to fill the existing needs for such background material. In order to accomplish this objective vis-à-vis Ceylon, the author draws freely upon the work of the "greats" in this field, notably A. S. Mendis, C. H. Fernando, F. Day, P. Deraniyagala, and I. Munro. A suggested bibliography (every entry of which was personally examined) follows the conclusion of the second part of this article and it is recommended that aquarists consult them for further information.



B. THE GEOGRAPHY OF CEYLON

The northern portion of the island rep-resents its low area, an area that actually extends to the center of the country (see Figure 1). This same low country can be found on the east, west, and southern coasts. The center of the lower (southern) half of Ceylon is mountainous, although these mountains are nowhere near as impressive as those of the Andes range or even of our own Rocky mountains (Ceylonese mountains range between 3000 and 8000 feet). This mountain belt is surrounded by a mid-level belt (1000 to 3000 feet).

During May to September, the mountain area causes heavy precipitation in the southwestern area while the remainder of the island receives little or no rain at all (these areas are delineated in Figure 1 by the dotted line). During November to February, rains due to offshore occurrences fall all above the mountains with the exception of the areas east and southeast. Except for the southwestern area, the entire coastal plain and the east slopes of the mountain area represent the dry portions of Ceylon.

C. THE WATERS OF CEYLON

As might be imagined, the rivers have their origin in the mountains. Such rivers flow out in all directions of the compass. We may classify the waters of Ceylon as follows (both the Sinhalese and Tamil terms are supplied so that the reader may follow Figure 1 more closely):

(1) Rivers: These are large, deep, flowing and never dry. The Ceylonese terms for rivers are "Ganga" (Sinhalese) and "Aru" (Tamil), and such terms are used in Figure 1.

(2) Streams: These are similar to, but smaller than the rivers. In flow they vary from torrential (in the mountains) to more or less stationary types. The native terms for streams are `"Ela" (Sinhalese) and "Aruve" (Tamil).

(4) Lakes: The lakes in Ceylon are sometimes natural but the majority are a result of irrigation reservoirs (called "tanks") constructed hundreds of years ago by building dams. The native terms for lakes are,"Wewa" (Sinhalese) and "Fri" (Tamil).

(5) Ponds: These are very small shallow lakes. The native terms are "Pokuna" (Sinhalese) and "Phadakam" (Tamil).

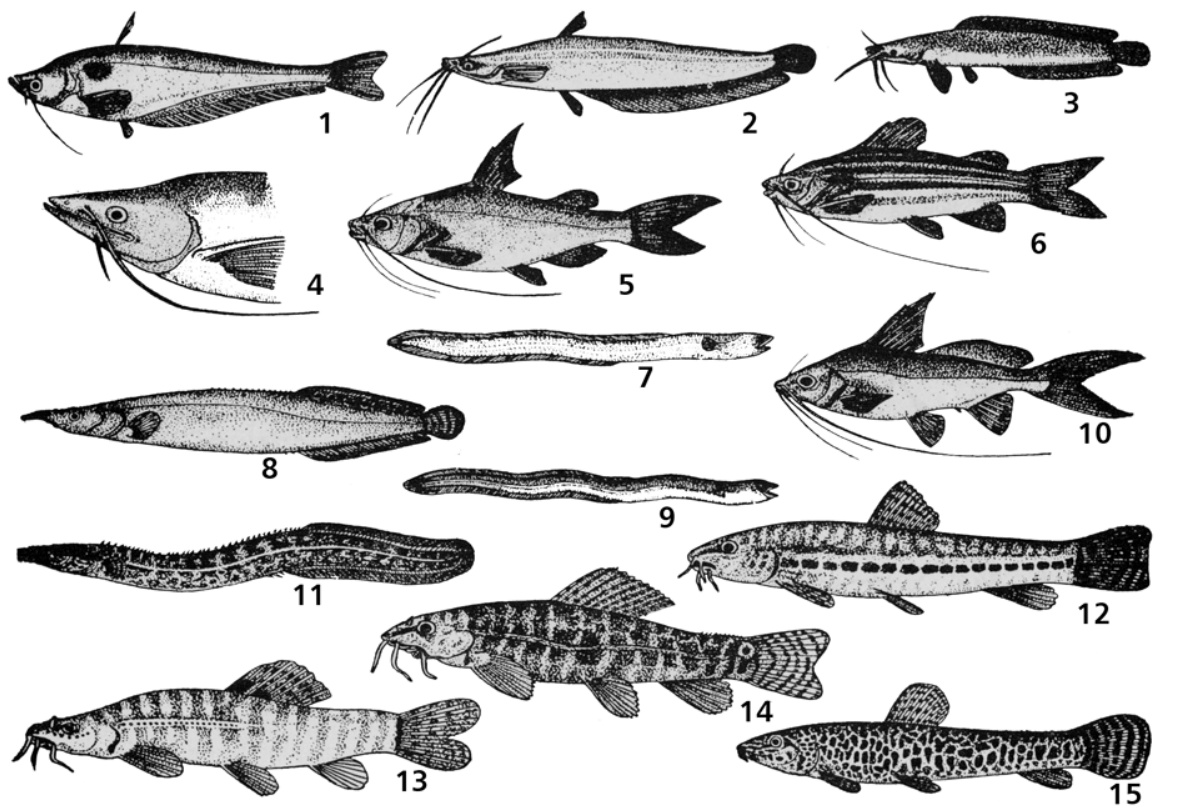


FIGURE 2: *1. Wallago attu, 2. Heteropneustes fossilis, 3. Clarias teysmanni brachysoma, 4. Ompok bimaculatus, 5. Mystus gulio, 6. Mystus vittatus, 7. Anguilla nebulosa nebulosa, 8. Macrognathus aculeatus, 9. Anguilla bicolor bicolor, 10. Mystus keletius, 11. Mastacembelus armatus, 12. Lepidocephalus thermals, 13. Noemacheilus notostigma, 14. Noemacheilus baler, 15. Lepidocephalus jonklaasi.*

(6)Flood Lakes: These may come or go, or else have some sort of permanence about them. Native terms are "Pitaravila" (Sinhalese) and "Perukhesi" (Tamil) or "Villu" (Tamil).

(7)Paddy Fields: These are temporary in that all water is drained off when the crop begins to ripen. Native terms are "Kumbura" (Sinhalese) and "Nell Vayal" (Tamil).

D. THE BIOLOGY OF CEYLONESE FRESHWATER FISHES

Of course, some fishes have extremely wide ranges (e.g., snakeheads) while others are more limited (e.g., *Barbus vittatus is* not present in rivers). In addition, within a given range, fishes occupy certain ecological niches *(Barbus vittatus* lives in only shallow waters; spiny eels are bottom dwellers). As pointed out in section B, drought conditions do prevail in certain areas of Ceylon, and its fishes have adapted accordingly. Thus, we have air breathers such as *Anabas, Channa, Clarias,* and *Heteropneustes.* Even spiny eels *(Macrognathus* and *Mastacembelus)* survive if their gills are kept moist.

The breeding of many Ceylonese fishes takes place during or after the rains when food is plentiful and water is not at a premium. Many species are extremely colorful during breeding, making them very desirable aquarium fishes. There are habits of Ceylonese fishes, which have not hitherto been reported in the aquarium literature. For example, in severe drought most species eat mud to utilize its decaying organic matter. The cichlid, *Etroplus suratensis,* when disturbed lies flat on the mud where it is overlooked by its enemies.

E. THE FISHES

We present now all the known species of freshwater fishes known to occur in Ceylon. No descriptions are furnished of fishes illustrated. If a fish not illustrated, however, is suitable for the aquarium, a description is given. At times, suitable nomenclatural notes are made when it is necessary.

A. Family Siluridae (Elongate and laterally compressed bodies; fins yellow; dull, silvery white on sides; two pairs of barbels; tails forked).
(1) *Wallago attu* (see Figure 2, number 1); the freshwater "shark". A large fish (up to 5 feet!), used for food. Not a suitable aquarium fish. Deep waters and irrigation tanks of the low country.
2. *Omnok bimaculatus* (see Figure 2, number 4); the butter catfish. Not as large as *Wallago* but still growing to 11/2 feet. Again, not really an aquarium fish.

B. Family Clariidae (Depressed heads, elongate bodies; four pairs of barbels; rounded tail-fin; air breathers for short periods).
1. *Clarias teysmanni* (see Figure 2, number 3). Length to 1 foot. Common in muddy streams and ponds. Nocturnal. Too big for an aquarium fish although some individual specimens may be kept as show-fish.
2. *Clarias nebulosus.* Even bigger than the preceding (up to 11/2 feet). Found in rivers at higher elevations.

C. Family Heteropneustidae
1. *Heteropneustes fossilis* (see Figure 2, number 2); the stinging catfish. This is an elongate catfish possessing four pairs of barbels and a rounded caudal fin. It reaches a length of 10-14 inches. Common in ponds and irrigation ditches, and may enter brackish water. The spine on each pectoral fin is capable of giving a nasty sting. Kept by some aquarists but the natives consider them a delicacy!

D. Family Bagridae (Subcylindrically shaped bodies; prominent dorsal spine; four pairs of barbels; caudal forked).
1. *Mystus vittatus* (see Figure 2, number 6); striped dwarf catfish. Length to 4 inches. Found in ponds and streams of low and mid-

country. I have kept this fish in the aquarium. In habits, similar to South American pimelodellas.
2. *Mystus keletius* (see Figure 2, number 10); dwarf catfish. Length to 5 inches. Common in rivers and streams.
3. *Mystus gulio* (see Figure 2, number 5); long-whiskered catfish. Length to 10 inches. Really a brackish water fish.

E. Family Anguillidae (These are the true eels; elongate fishes with snake-like bodies; no ventral fins; migrate to sea for breeding but grow to maturity in fresh-water).
1. *Anguilla bicolor bicolor* (see Figure 2, number 9); level-finned eel. Length to two feet. Common in streams, rivers, and swamps near coast.
2. *Anguilla nebulosa nebulosa* (see Figure 2, number 7); long finned eel. Grows even larger than the preceding! This eel found in hill-country pools.

F. Family Mastacembelidae (These are the "spiny eels" of the aquarist: mud-loving creatures, eel-like; pointed snout and row of spines in front of soft dorsal fin).
1. *Macrognathus aculeatus* (see Figure 2, number 8); lesser spinet' eel. Length to 10 inches. Found in streams, ponds and tanks in low country. Used as aquarium fish for years. Distinguished from next fish by fact that caudal fin is distinct from dorsal and anal.
2. *Mastacembelus armatus* (see Figure 2, number 11); spiny eel. Length to 25 inches. Inhabits flowing and still waters up to 4000 feet above sea level. Distinguished from preceding fish by fact that caudal, dorsal and anal all grow into each other.

G. Family Cobitiidae (These are the loaches. All are small fishes with 3 or 4 pairs of barbels. Most have stripes or spots. Bottom feeders. All good aquarium fishes**).**
1. *Lepidocephalus jonklaasi* (see Figure 2, number 15). Both species of *Lepidocephalus* have four pairs of barbels. Found only in shaded pools of hill streams.
2. *Lepidocephalus thermalis* (see Figure 2, number 12); lesser loach. Found only in hot springs near Trincomalee.
3. *Noemacheilus botia* (see Figure 2, number 14); striped loach. Found in small streams in low country.
4. *Noemacheilus notostigma* (see Figure 2, number 13); spotted loach. Found in hill country streams.

The Penguin or Hockeystick Fishes Genus *Thayeria*

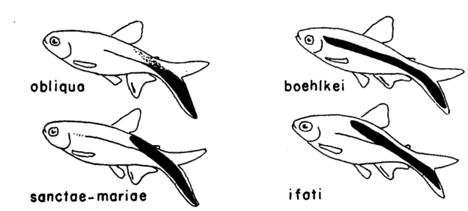
[Tropicals Magazine, Ichthyologica, Spring 1961]

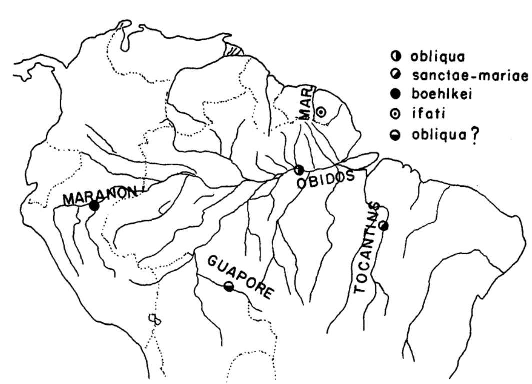
In 1935, the first *Thayeria* was imported into the United States. After a short masquerade under the nom de plume, "*Hemiodus* species," it became known to aquarists as "*Thayeria obliqua*." The popular, "penguin fish," is an invention of British aquarists and has been adopted by French aquarists as well (Le Pingouin). Dutch aquarists, on the other hand, frequently employ the very descriptive term, "hockeystick fish."

It has since been determined that original *Thayeria* imported ("*Thayeria obliqua*") was, in reality, *Thayeria boehlkei* and to this day, the vast majority of *Thayeria* seen by aquarists are of this species. There are four species of *Thayeria* known to science and they may nicely be separated into two groups: those in which the length of the lower lobe of the tail fin greatly exceeds that of the upper lobe (*Thayeria obliqua* and *Thayeria sanctae-mariae*), and those in which these two lobes are almost equal (*Thayeria boehlkei* and *Thayeria ifati*). For an aquarist's differentiation of these four species, consult Figure 1. There is some question as to whether *T. obliqua* and *T. sanctae-mariae* are really different species. Recently, Dr. Gery, the French ichthyologist, examined the type specimens for *T. sanctae-mariae* and compared them with specimens of *T. obliqua* as determined by our own Dr. Stanley Weitzman of Stanford University. Dr. Gery could find no differences other than that the oblique black band is almost absent in the body of *T. obliqua*. Whereas in *T. sanctae-mariae* this band continues strong from the tail fin to the posterior base of the dorsal fin, it peters out into a faint pattern in the case of *T. obliqua*.

The known habitats of these four species are shown in figure 2. They include the lower Rio Nucuray, a tributary of the Rio Maranon in the surroundings of Concordia, for *Thayeria boehlkei.* This is in the Loreto district of Peru, after which a common aquarium tetra was christened. For *Thayeria obliqua*, we have Obidos at the Amazon River, Brazil (also recorded more south, from the Rio Guapore, which separates Bolivia from Brazil); for *Thayeria sanctae-mariae* it is southwards of Carolina on the Rio Tocantins, Brazil; and for *Thayeria ifati*, it is Gaa Kaba on the Maroni River (French Guiana).

From the map, we see that these known habitats are clearly discontinuous, implying that





Distribution of species of *Thayeria*.

these fishes may have descended from more than one ancestral type. On the other hand, the patterns of these fishes suggest that they all derive from some fundamental type. In any event, the aquarist should be able to identify species of *Thayeria* relatively easily.

The Five- and Six-Striped Barbs

[Tropicals Magazine, Ichthyologica, Summer Issue 1961]

Aquarists frequently complain bitterly about changes in the scientific names of aquarium fishes and if one has a phobia about it, then this is definitely the wrong column to read. From time to time, we shall mention many of these name changes. For example, consider the five-striped and six-striped barbs, typified by the popular aquarium fishes, *Barbus tetrazona* and *Barbus hexazona*, respectively.* In 1912, the l team of Weber and de Beaufort described *Barbus hexazona*, noting its habitat as the island of Sumatra. Four years later, they suggested that perhaps this "species" was not really a species at all but rather just a subspecies of *Barbus pentazona*. The latter fish, by the way, was named by Boulenger in 1894 and described as coming from Borneo and the Malayan peninsula but not from Sumatra (which lies south of the Malayan peninsula). Then in 1939, the German aquarist-ichthyologist, Herman Meinken, declared *hexazona* to be only a variety of *Barbus pentazona* and called it, *Barbus pentazona* var. *hexazona*. The British scientist, Fraser-Brunner, and the German aquarist, Sterba, backed him up.

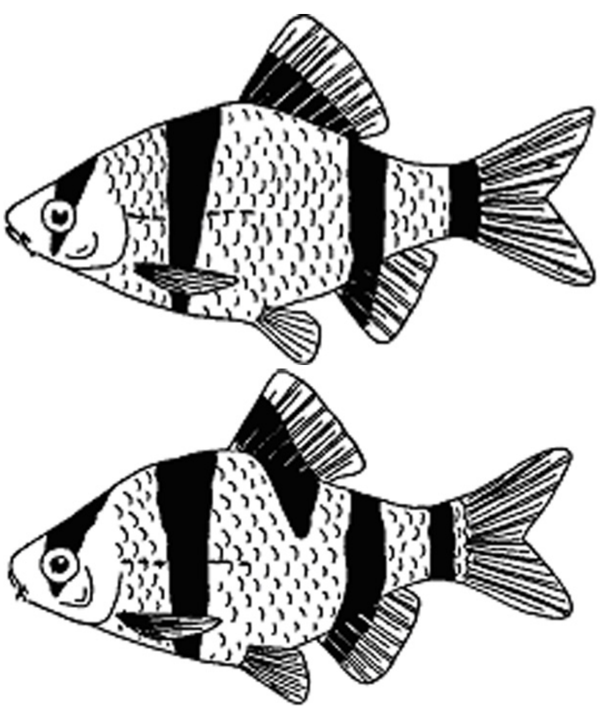


Figure 2.
Top: *Barbus tetrazona tetrazona*
Bottom: *Barbus tetrazona partipentazona*

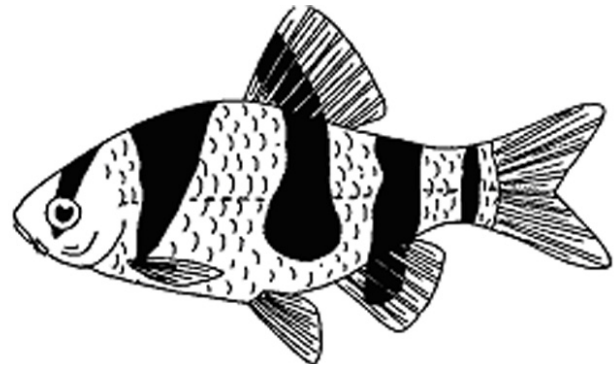


Figure 3.
***Barbus pentazona* "var. *tetrazona*"**

However, the term, "variety," has no scientific nomenclatural status today. In these circumstances, a fish is either a subspecies or it is not. Individual variants do not qualify for subspecific status. In response to a request by Dr. Klausewitz of the Museum of Natural History and Research (Senckenberg, Germany), Dr. Trewavas of the British Museum determined that this indeed was a subspecies and the names, *Barbus pentazona pentazona* and *Barbus pentazona hexazona* are correct. The differences between the two subspecies are clearly illustrated via the patterns in figure 1. Thus, our old friend *Barbus hexazona* turns out to be a subspecies of *Barbus pentazona*! At one time in the earth's history, a land bridge existed between Australia and East Asia.

When the land between them sank, a number of species became separated within themselves, permitting some degree of independent evolution but not to the extent of forming separate species. This is the case with the fishes just discussed.

In much the same manner, we make a case for the five-striped barbs. In 1934, Fowler described *Barbus partipentazona* from Thailand. Meinken in 1939 suggested that it belonged to the *tetrazona* group. Following its story on down, today we recognize that we have two subspecies, *Barbus tetrazona tetrazona* and *Barbus tetrazona partipentazona* (see figure 2). Our old friend, the tiger barb (which formerly was incorrectly known as *Barbus sumatranus*), is the first-named of these and *partipentazona* is relegated to that of a subspecies.

Finally, we say a few words about *Barbus pentazona* var. *tetrazona* (see figure 3). At the present, it is not known whether or not this is a subspecies or just an individual variant. In any event, two things are certain: (a) It belongs to the *pentazona* group and (b), its name is not valid. The International Rules of Zoological Nomenclature do not permit the same specific or subspecific name to be used twice within the same genus. Since *tetrazona* is already reserved, should it prove to be a valid subspecies of *Barbus pentazona*, a new sub-specific name will have to be devised.

Name changes are confusing but they are the result of the steady addition to our rather limited state of knowledge. In this particular case, the name changes suggest possibilities for crossbreeding (by the very definition of the word "species," the subspecies must crossbreed) and perhaps more interesting aquarium fishes may result. Imagine a tiger barb (with its beautiful colors) having the docility of *partipentazona*!

***In a future column, we shall discuss the validity of using the name "*Barbus*," at all.**

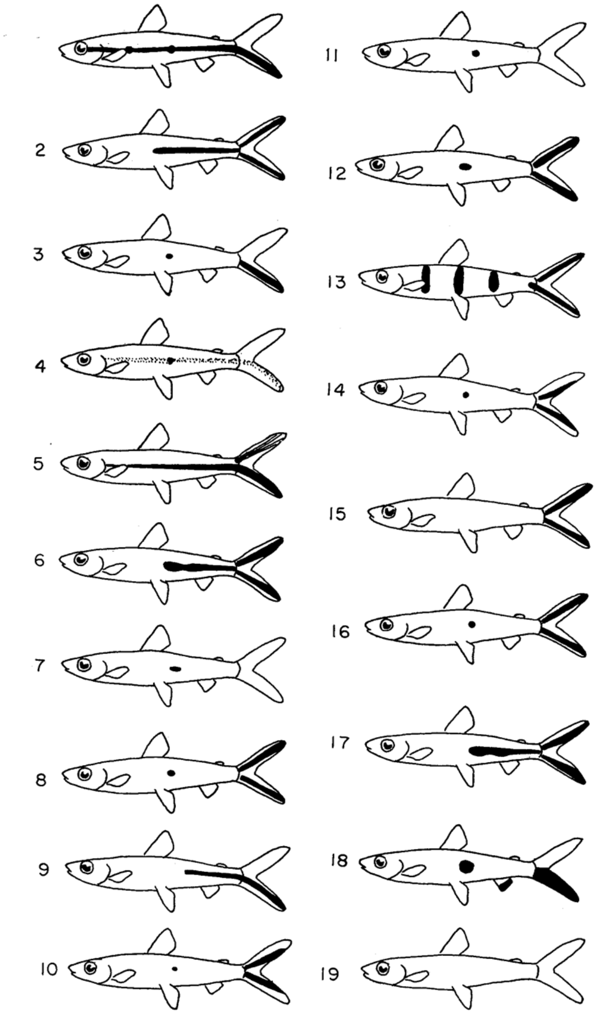
Hemiodus and Related Fishes

[Tropicals Magazine, Ichthyologica, Fall Buyer's Issue 1961]

The hemiodontine group of aquarium fishes can be conveniently divided into two tribes: Hemoidontidi and Nannostomidi. The latter tribe will instantly be recognized by the hobbyist as containing the familiar pencil fishes. The former, on the other hand, contains the genera *Hemiodus, Pterohemiodus* and *Anisitsia*; however, only the first-named is a consistent source of aquarium fishes. In general, the hemiodontines are characterized by their elongated, silvery bodies, containing some sort of black pigmentation arranged in distinct patterns. Dr. James Boehlke of the Academy of Natural Sciences of Philadelphia has postulated that all of these color patterns are derivable from one fundamental type, viz., an intense uninterrupted black stripe from the rear of the gill cover to the base of the tail, turning downward to run to the tip of the lower tail lobe. Even the odd *Hemiodus quadrimaculatus* pattern can be shown to have a basis in the side spots that sometimes are present on the dark longitudinal line.

The color patterns then, are a decided help to aquarists in identifying the hemiodontine fishes. To date, the following species of *Hemiodus* have been imported as aquarium fishes although undoubtedly, others have also been imported but never were identified: *Hemiodus argenteus, Hemiodus gracilis, Hemiodus semitaeniatus* (the first *Hemiodus* imported as an aquarium fish - 1912), *Hemiodus unimaculatus, Hemiodus microlepis*, and *Hemiodus quadrimaculatus*. From time to time, some of these have been misidentified. For example, *Hemiodus argenteus* has frequently been confused with *Hemiodus semitaeniatus*.

As a result of Dr. Boehlke's work aquarists are able to make relatively easy identifications of these fishes, both for those already imported



Legends to Drawings
(all figures after Boehlke).

1. Hemiodus ternetzi
2. *Hemiodus fowleri*
3. *Hemiodus argenteus*
4. *Pterohemiodus atranalis*
5, Hemiodus thayeria
6. *Hemiodus goeldi*
7. *Hemiodus longiceps*
8. Anisitsia othonops
9. *Hemiodus gracilis*
10. *Hemiodus rodolphoi*
11. *Hemiodus microlepis*
12. *Anisitsia notata*
13. *Hemiodus quadrimaculatus*
14. *Hemiodus unimaculatus*
15. *Hemiodus immaculatus*
16. *Anisitsia kappleri*
17. Hemiodus *semitaeniatus*
18. Hemiodus parnaguae
19. *Anisitsia amazona*

and for those yet to come. The sketches are idealized as to body shape and are intended to illustrate color patterns only. Remember too, that to some extent a fish's markings are a function of its environment and its nervous state. Aquarists should study their fishes for some time under varying conditions before completing their identification. A few of the patterns are difficult to tell apart from others; however, the sketches do narrow the field for the aquarist considerably!

The *Barbus* Question

[Tropicals Magazine, Ichthyologica, Christmas Gift Issue 1961,]

For a number of years, aquarists have been plagued with the uncertain taxonomic status of the genus *Barbus*. Since this problem is one of the most difficult and confusing in the whole of ichthyology today, aquarists have not been the only ones so plagued. There is hardly an ichthyologist who has dealt with barbs from the three continents of Europe, Africa and Asia, who would not agree that these fishes comprise more than one genus… the controversy is over what should be done about it. Historically, a number of ichthyologists working in restricted geographical areas have subdivided *Barbus* in accordance with the apparent requirements of the geographical area of interest. Thus, Drs. Myers and Oshima subdivided *Barbus* in China and Formosa; Boulenger in Africa; and Weber and de Beaufort in the former Dutch East Indies (Borneo, Indonesia and Singapore Island). The last-named attempt was rather successful, resulting in the widespread use of the genus, *Puntius,* both in the scientific and aquarium worlds. German aquarists, in particular, were quick to adopt *Puntius* for all aquarium barbs, and the practice was introduced into this country mainly via the efforts of H. R. Axelrod. This was and still is, however, a highly indefensible practice.

Although the Weber and de Beaufort system was used fairly successfully by Dr. Hugh

Smith for the barbs of Thailand, other ichthyologists found difficulty in applying these (Weber and de Beaufort's) criteria in their own areas of interest. Thus Hora, the Indian ichthyologist, continued to recognize *Barbus* in his papers on the fresh-water fishes of India, and no ichthyologist working with African barbs has chosen to abandon *Barbus* there. In short then, the practice in ichthyology has been for those dealing with Indonesian and Siamese fishes to use *Puntius* reverting, however, to *Barbus* for European, African and other Asian barbs (we are, of course, simplifying matters considerably by restricting discussion so far to *Barbus vs. Puntius).* Those aquarists lumping African barbs, for example, under *Puntius* are making an egregious error, indeed.

A number of years ago Dr. Schultz, writing in the Tropical Fish Hobbyist magazine, stated that aquarists should use the following three genera, based mainly upon the number of barbels: *Capoeta (2* barbels), *Puntius* (no barbels), and *Barboides* (4 barbels). We strongly advise against this. This system is open to considerable criticism (which is too technical and involved to discuss thoroughly here) and at best, is quite premature. Dr. Schultz seemingly has ignored the real problem with *Barbus,* that of the evolutionary considerations with-in this great group. It will take more than an article in an aquarium magazine to untangle the confusing phylogenetic lines involved. So far as barbels are concerned, we quote Dr. Myers on this: "It seems almost certain that the reduction or loss of one or both pairs of barbels has occurred independently in different evolutionary lines, and may thus be of no importance in establishing genera defined solely by such losses".

The l world is sorely in need of a revisional work on *Barbus,* based upon thorough and intelligent study of both external and internal anatomy, together with studies on geographical distribution. It seems probably the case that such a study would show that the number of present species should be reduced, that in reality, many existing "species" are merely subspecies. Such a study would involve a tremendous number of fishes, not merely a handful of the 400 or 500 "species" now chronicled.

So far as the aquarium world is concerned, it is recommended that *Barbus* be utilized for all aquarium barbs until that time at which the ichthyologists have produced a satisfactory revision (aquarists should expect a long wait!). Aquarists are not ichthyologists and therefore are hardly justified in using the specialized nomenclature of *Puntius* (et al.) in the case of Indonesian and Siamese barbs. It would only complicate matters since the use of *Puntius is* definitely not justified for African and other Asian barbs, in any case. The terms, "*Capoeta*" and "*Barboides*" should be dismissed quickly by all aquarists, at least for the time being.

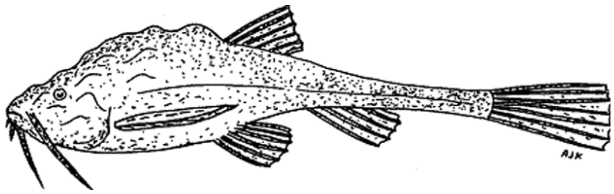
The author is indebted to Dr. George S. Myers of Stanford University for much of the information contained in this month's column.

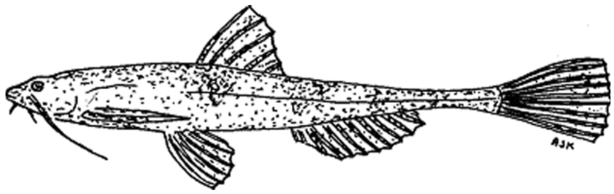
The Banjo Catfishes

[Tropicals Magazine, Ichthyologica, May-June 1962]

Since 1871, ichthyologists have recognized a small group of catfishes, known as the Aspredinidae, as a separate family. The distinctiveness of this family was recognized early, because in 1871 few families of catfishes were recognized as being separable from the then giant of them all, the Siluridae.

In British Guiana, the native name for the Aspredininae (one of the two sub-families of this family) is "banjaman" or "banjo-man," a result of the resemblance these fishes have to a banjo. In Brazil, aspredinids are known as





Top: ***Agmus lyriformis***
Bottom: ***Bunocephalus albifasciatus***

"rabeca," the name for a fiddle or violin. Aquarists have eagerly adopted the term, "banjo catfish," and today it serves as an admirable vernacular name in the hobby.

The two subfamilies are: Aspredininae and Bunocephalinae. They are so distinct from each other in both habitat and anatomy, that some ichthyologists have placed them into separate families (Aspredinidae and Bunocephalidae). From an aquarium viewpoint, I favor this latter stand but until the ichthyologists do some needed anatomical work, one can leave it as one family with two subdivisions.

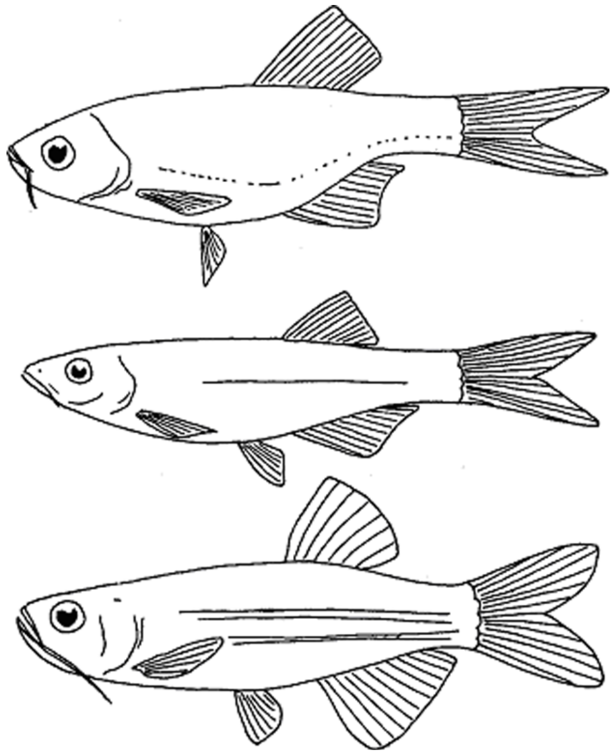
The two subfamilies could (and is, in fact) be easily distinguished by virtue of a significant difference in the anal fin, one sub-family (Bunocephalinae) having a very short anal fin consisting of 12 or fewer rays, and the other having a very long anal fin of 50 or more rays. However, the anal-finned fishes are strictly freshwater fishes found in streams at relatively low altitudes, principally shaded forest brooks and tributaries of rivers. All of them like some current, however, and frequently occur in near riffles or rapids. The long anal-finned forms, on the other hand, are saltwater fishes or fishes which enter freshwater only in estuaries and within tidal influence. Thus, only the Bunocephalinae are of interest to aquarists. There are five genera in Bunocephalinae, but only two of them have been imported as aquarium fishes: *Bunocephalus* and *Agmus*. The former comprises over half the known species of the entire family. They are all smallish fishes, usually less than 6 inches in length. Many are imported from British Guiana and the Amazon basin, from the vicinity of Leticia and Tabatinga (Peru, Columbia and Brazil). Fewer numbers of *Agmus*, also comprising smallish species, have been imported. *Agmus* contains but two species, *Agmus lyriformis* from British Guiana, and *Agmus scabriceps* from Brazil.

The point now is, how does the aquarist differentiate between *Bunocephalus* and *Agmus*? Fortunately, it is quite simple. *Bunocephalus* has an extremely depressed head such that the depth of its head is about equal to one-half of its greatest width. *Agmus*, on the other hand, has a very deep head, so much so that its depth is about equal to its greatest width. This easy observation will enable the aquarists to place his fish in the correct genus, the species identification being too complex for this short column. It should also be noted that although the heads of both genera are wrinkled and have a texture somewhat reminiscent of a pineapple (!), *Agmus* is excessively wrinkled or rugore as the ichthyologists term it. Incidentally, aquarists have succeeded in breeding species of *Bunocephalus* and report that the eggs are carried attached singly to the belly of the female. This appears to be the case also with other members of the family, as well.

Danio vs. *Brachydanio*

[Tropicals Magazine, Ichthyologica, July-August 1962]

The genus *Danio* was established in 1822 by the noted ichthyologist, Hamilton, and consisted of a number of small, brightly colored fishes commonly inhabiting fairly swift mountain waters. These fishes are quite well known among aquarists. In 1916, just a bit short of 100 years later, the team of Weber and de Beaufort proposed dividing *Danio* into two



From Top to Bottom:
Danio (Danio) peninsulae
Danio (Allodanio) ponticulus
Danio (Brachydanio) kerri
(after Smith)

subgenera, viz., *Danio* and *Brachydanio*. At that time, the split was a fairly obvious one, *Danio* including those forms having 112 to 16 branched rays in the dorsal fin together with a complete lateral line, and *Brachydanio* including those in which the lateral line was either incomplete or else missing entirely, and possessing only 7 branched dorsal rays. The very name *Brachydanio* means "short *Danio*" and refers to the short dorsal fin. Over the years, ichthyologists including Dr. Myers and Dr. Hora elevated *Brachydanio* to full generic status, a move that was fully justified by the material available to them at that time. Thus, aquarists have known two separate and distinct genera, *Danio* and *Brachydanio*.

It appears now, however, that there is really no sharp delineation between these two "genera" and it is advisable that *Brachydanio* be dropped as a valid genus and relegated back to its former role as a subgenus. There is too much intergradation between them as far as the two characters that formerly differentiated these genera are concerned. For example, *Danio naganensis* (from India) has only 8 branched dorsal rays but a complete lateral line. *Danio shanensis* (from Burma) has 7 branched rays and normally an incomplete lateral line but occasionally, specimens have been found with complete lateral lines. On top of this, *Danio ponticulus* (from Thailand) combines 7 rays with a complete lateral line as a matter of course, suggesting a third subgenus.

Therefore, today, the genus *Danio* is subdivided as follows:

A. Lateral line complete, branched dorsal rays 8 to 17…subgenus *Danio*
B. Lateral line absent or normally incomplete, branched dorsal rays 7…subgenus *Brachydanio*
C. Lateral line complete, branched dorsal rays 7…subgenus *Allodanio*

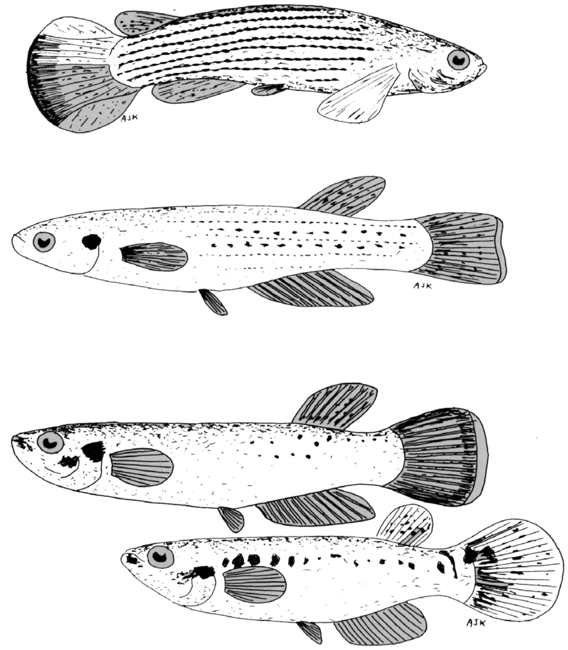
There is one consolation in this nomenclatural change . . . now aquarists have only one, very short name to remember!

The Identity of the Goldentail Rivulus (GTR)

[Tropicals Magazine, Ichthyologica, September-October 1962,]

The goldentail rivulus (GTR) was introduced into the American aquarium literature in 1956 by the well-known aquarium authority, Jacob Scheidnass, of Philadelphia. Presently, it is very much in evidence and since it is easily kept and bred in the home aquarium, the only problem remaining is that of providing a scientific name for it, al-though exact locality information would be a useful adjunct also.
In 1956, hobbyists were obtaining many fishes

from British Guiana and so the GTR fell heir to the name of a prominent rivulid from that area, viz., *Rivulus holmiae*, a fish that has been the object of some minor confusion in ichthyology, and a somewhat variable subject besides. In any event, the GTR is not *Rivulus holmiae*. This fish is a much more lanky fish whereas the GTR is more chunky (resembling more the body form of the more familiar *Rivulus cylindraceous*). The true *Rivulus holmiae* (the males, that is) sports a series of longitudinal rows of red dots, the dots in question being close enough to touch each other frequently. The interstitial areas between these rows of red spots are medium-green. More interesting is the tail fin in *R. holmiae*. The upper and lower intramarginal areas are colored pale green, these areas being margined with a thin black line above and below. The posterior portion of this fin is dark, definitely not pale (see figure). This situation is essentially the opposite of that found in the GTR. *Rivulus holmiae* is closely related to *Rivulus hartii*, another fairly well known rivulid.



TOP: *Rivulus holmiae*.
MIDDLE: *Rivulus elegans* (after Steindachner).
BELOW: *Rivulus milesi* (after Fowler).
Male above, female below.

More closely related to the GTR are fishes in the series, *R. tenuis, R. godmani, R. elegans, R. leucurus*, and *R. magdalenae*. These are all fishes with yellow-orange posterior borders to their caudal fins. *Rivulus elegans* is especially close to the GTR and indeed, this name has been applied to the GTR frequently. The closest description in the scientific literature to the GTR is, however, *Rivulus milesi*, a fish described from Columbia by the American ichthyologist, Fowler, in 1941. The matter would rest here were it not for the fact that *Rivulus elegans* and *Rivulus milesi* are so close.

Morphologically, they are almost identical except that *R. elegans* is somewhat slimmer in body shape. Both Steindachner's 1880 description of *R. elegans* and Fowler's of *R. milesi*, however, do not quite capture the pattern present on the sides of the fish we know as the goldentail rivulus. Steindachner would make this to be a pattern of more or less longitudinal rows of spots; Fowler figures it as but a brief series of spots near the tail root (in the males). This is a minor point, however, in light of the fact that scale and fin counts are so close. Even in the unusual feature of having a tail fin heavily scaled in its anterior portion, *R. elegans, R. milesi* and the GTR agree.

For the present, here the matter must lie. Since Fowler's description of *R. milesi* fits so well morphologically, I prefer calling the GTR by this name now, but I feel that ultimately, there is a good chance that *Rivulus elegans* and *R. milesi* will be found to be one and the same species. If this comes to pass, then the correct name for the GTR would be *Rivulus elegans* by virtue of priority. In any event, the use of the name *Rivulus holmiae* is definitely incorrect. With this statement, no ichthyologist quarrels.

The Genus *Loricaria*

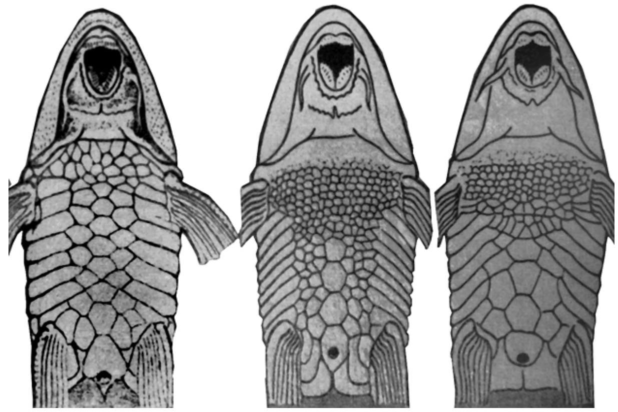
[Tropicals Magazine, Ichthyologica, November-December 1962]

The family of catfishes known as Loricariidae consists of fishes protected with an armor of bony plates, possessing an oral sucker and displaying the characteristic catfish barbels. Internally, one very striking characteristic of the fishes within this family is the presence of a very long, much recoiled intestine. This organ greatly resembles the spring of a watch. A long intestine is common to vegetarian fishes and the members of this family form no exception to this general rule.

Perhaps one of the most interesting members of this family is the genus *Loricaria,* an aggregation of elongated catfishes. Unlike some other members in the family *Loricaria* lacks an adipose fin and in general, possesses a much shorter intestine. In Peru, the common name, "shitari," is applied to the genus and some closely related genera.

From time to time, *Loricaria* have been bred successfully in the aquarium. They are rather easily sexed, the males being larger and having a hexagonally shaped head (actually 2/3 of a hexagon … two sides of the hexagon are absorbed to connect the head to the body) as seen from above. Females, on the other hand, have a more triangularly shaped head. Unfortunately, however, different species of *Loricaria* are frequently imported together and mixed in shipments, and aquarists have been fooled into selecting two fish, each from different species, as a "pair."

The identification of the species within *Loricaria* is a difficult matter and not really within the capabilities of aquarists. It is a job for a specialist, one with special training in the field. It again points up the difference between being an aquarist and being an ichthyologist and the two should not be confused. Just as an example of what ichthyologists look for in identifying *Loricaria* species (just one among many characteristics, however), scan the drawing of three species of *Loricaria.* Notice that there is a decided difference among the ventral plate patterns of these fishes. In a way, they serve as a "fingerprint" 'for each species but as few of us are fingerprint specialists, we are forced to forego any concise and nice way in which to provide aquarium identifications for the myriad of species that comprises the genus.



FROM LEFT TO RIGHT: Loricaria parva, Loricaria microlepidogaster, and Loricaria lanceolata.

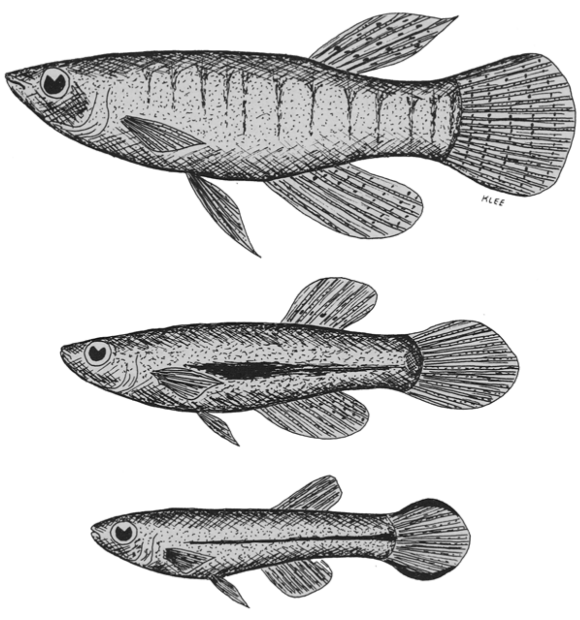
Aquarists can take the job of identification of fishes just so far and even among those most interested in the subject, mistakes are frequently made. I myself recently "goofed" in identifying a catfish (see "Reader Comments" in the July-August 1962 issue of TROPICALS … the renowned American aquarist, Gene Wolfsheimer, kindly made the needed correction) proving once again that jumping to conclusions isn't as good as digging for facts!

Micropanchax vs. *Aplocheilichthys*

[Tropicals Magazine, Ichthyologica, Holiday Issue 1962]

Among those fishes popularly known to aquarists as the "lampeyes," we find a relatively large group usually lumped under the single genus, *Aplocheilichthys.* As a short refresher, the lampeyes are killifishes found only in Africa and, with the exception of but a single species, those included under *Aplocheilichthys* are rather minute fishes, even as aquarium specimens go. In general, they are conceded to be somewhat more difficult to breed than the usual African killifish, mostly because of their small size and low egg production.

In 1924, Dr. George S. Myers split *Aplocheilichthys* into two genera: *Aplocheilichthys* and *Micropanchax.* The latter included the very smallest of these fishes such as *Micropanchax schoelleri.* After examining a large number of species (there are, perhaps, 40 or so species that could be considered as belonging to this group), however, Dr. Myers concluded that one species graded into the next and that it was difficult to draw a logical dividing line separating the two genera, a situation somewhat suggestive of that confronting *Aphyosemion* and its "subgenera." In any event, he abandoned *Micropanchax* and considered all species of this group as belonging to *Aplocheilichthys.* This is how the matter has stood for many years in the aquarium hobby.



Representative Lampeyes drawn to relative scale. From top to bottom:
Aplocheilichthys spilauchen
Micropanchax katangae
Micropanchax schoelleri

In 1942, Dr. L. P. Schultz, of the Smithsonian Institution, resurrected *Micropanchax* on the basis of several significant features of anatomy of these fishes. Dr. Eth. Trewavas of the British Museum, and Dr. Myers, concurred and today, it seems best that aquarists take cognizance of this change in nomenclature. Dr. Myers formally re-recognized the genus *Micropanchax* in 1955, and it is about time aquarists followed suit.

At the present, there appears to be only one species of *Aplocheilichthys, viz., Aplocheilichthys spilauchen.** Since it has been imported as an aquarium fish, aquarists cannot forget about *Aplocheilichthys* entirely! Those tiny species such as *schoelleri* and *myersi,* on the other hand, definitely belong in *Micropanchax.* Dr. Trewavas has kindly allowed me to quote from her letter to me:

"There are some species formerly placed in *Aplocheilichthys* which may be neither this nor *Micropanchax;* such are *pumilis* and *katangae,* but these are at any rate nearer to *Micropanchax* than *Aplocheilichthys* and might be placed there temporarily."

Because I was interested in the technical differences between the two genera, Dr. Trewavas supplies the information that the genus *Micropanchax* was based upon the low number of pectoral rays and the structure of the maxillary (jaw) bone of its species. From an aquarist's standpoint, the lone species of *Aplocheilichthys* stands out like the proverbial "sore thumb" (see figure 1)!

***In many references, this is incorrectly spelled, *"spilauchena,"* due to some confusion re gender. Originally, this fish was placed in *Poecilia,* hence the original feminine ending.**

Aplocheilichthys spilauchen is a relatively large fish and is somewhat less delicate in shape. It is also interesting to note that of all of the lampeyes in this group, *spilauchen is* the only one that habitually is found in brackish water areas. Thus, the habitat of *Aplocheilichthys* differs considerably from that of *Micropanchax.*

In summary, it is suggested that aquarists follow the lead of these eminent ichthyologists and adopt the term *Micropanchax* for all species of this group with the single exception of *spilauchen.*

Channa vs. *Ophicephalus*

[Tropicals Magazine, January-February 1963, Ichthyologica]

A proper history of the aquarium hobby through the years will chronicle numerous instances of missing ventral fins in fishes that normally possess them in their natural state. We are not considering now fins removed or torn as a consequence of mechanical damage, but rather of fishes in which ventral fins are either reduced or lacking altogether as a result of some inherent defect. Among the fishes in which this has occurred have been: *Barbus tetrazona, Barbus nigro fasciatus, Colisa labiosa, Colisa lalia, Pterophyllum eimekei, Xiphophorus maculatus*, and *Xiphophorus variatus*. Undoubtedly readers have noted such defects in other species as well (especially in fry). The causes of this condition are not known with certainty but there is some evidence that it is perhaps a result of some dietary deficiency and/or an arrested period in the early stages of development of the fish.

From time to time, the presence or absence of ventral fins has had some influence on classification, one example being the snakeheads. The snakeheads are labyrinth fishes, which have appealed to some aquarists on the basis of their rather unusual shape (hence their popular name). For generations, the Chinese have kept solitary specimens of snakeheads as household pets and as such, the fish perform very well. For one thing, being labyrinth fishes they require very little water. They tame rather easily and quickly learn to take pieces of canned shrimp, for example, from their owner's fingers. Because they have no bright colors (they do have an interesting and pleasing pattern of markings, however) and because they are large fishes as aquarium specimens go (in their natural habitat, they are often used as food fishes), the snakeheads have never been popular fishes in this country. They serve mostly as aquatic "conversation pieces," so to speak.

The snakeheads have long been divided into two genera: *Channa* (described by Scopoli in 1777) and *Ophicephalus** (described by Bloch in 1793). This separation came about largely through the fact that species of *Channa* were observed to lack ventral fins, while *Ophicephalus* had them. However, subsequent investigation brought forth the fact that there were some *Ophicephalus*, which commonly lacked at least one ventral fin. In Ceylon, for example, a definite tendency towards absence of ventral fins was noted. Consequently, Myers and Shapovalov in 1933 called the two generic terms synonyms for one another, and on the basis of priority, deemed that the genus *Ophicephalus* be dropped from usage. In one respect this was unfortunate since *Ophicephalus* was a widely used term, while *Channa* was little known. Nevertheless, the correct generic term for aquarists to use is *Channa* (pronounced, KAN'-NA).

*** In some old texts this is spelled, *Ophiocephalus*." This is, however, incorrect.**

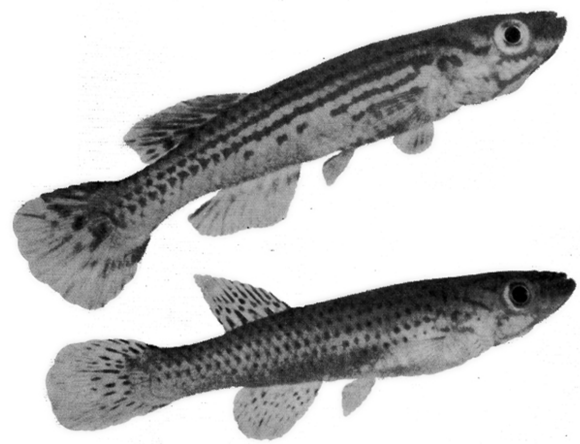
Aphyosemion striatum vs. *Aphyosemion lujae*

[Tropicals Magazine, Ichthyologica, May-June 1963]

In the year 1960, a brand-new *Aphyosemion* was imported into the United States from the Congo. It was unique among Congo killies of that genus in its possession of a very special feature, viz., a series of longitudinal dark bands between the rows of body scales. Although it was shipped under the name, *Aphyosemion striatum,* a subsequent article about this fish (Aquarium Journal, February 1961) gave impetus to the widespread use of the term, *Aphyosemion lujae.* At that time, two factors militated against the use of the term, *striatum:*

(1) There was some doubt whether *striatum* was an *Aphyosemion* or an *Epiplatys.* In one of his works (*Notes sur les Cyprinodontidae du Musee du Congo belge*, 1951), Dr. Max Poll (the leading authority on African fishes) referred this fish to the latter genus as *"Epiplatys striatus."*
(2) Certain evidence suggested that the fish then known to aquarists as *"Aphyosemion calliurum",* might be *striatum* should it be referable to *Aphyosemion.*

It has been shown since then, that both views were in error. Not only is *striatum* a true *Aphyosemion,* but the mystery of *"Aphyosemion calliurum"* also has been removed. The latter has been shown to be a new fish and recently, it was described as *Aphyosemion nigerianum* by the Danish zoologist, Stenholt Clausen. We shall probably say more about this development in a future column. *Aphyosemion lujae,* on the other hand, is a fish related to *Aphyosemion christyi* and indeed, may be a synonym for it. If this proves true (the evidence is not sufficient yet to prove it one way or the other), *lujae* will replace *christyi* on the basis of priority (1911 vs. 1915). *Aphyosemion lujae is* found far from *A.*



A pair of *Aphyosemion striatum* (photographed by Albert J. Klee).

striatum, which is found near the West Coast of Africa, in the regions of Pointe Noire and Dolise. *A. lujae,* on the other hand, originates from the Kasai Province, exact locality Kondue on the Sankura River. This is a considerable distance inland, and much farther south.

Fairly close neighbors to *A. striatum* are *A. labarrei* and *A. cameronense.* Recent shipments have tended to include both *striatum* and *labarrei, so* perhaps the future will find importers bringing in *cameronense,* also. Contrary to some literature reports, it is every bit as beautiful as its two cousins.

Aphyosemion striatum may prove to be a bit of a problem fish since it is already known that the young are extremely slow growing. However, the author recently received a pair of these fishes from Fraser Tulk, of New York, and a small thermometer that Fraser included in the shipping container registered 54° F upon arrival! The fish were, in spite of this remarkable temperature situation, in excellent condition and still are, for that matter. I sometimes wonder that a good deal of misinformation isn't being circulated about killies and their requirements in general. The natural habitat of *Nothobranchius brieni,* for example, undergoes a temperature as low as 36° F regularly during certain times of the year! In any event, aquarists should take note of the correct name of the fish shown in our illustration … *Aphyosemion striatum.*

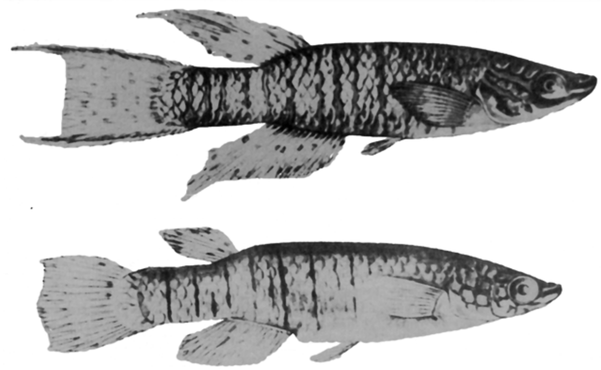
Aphyosemion nigerianum
Aphyosemion cinnamomeum
Aphyosemion rubrifascium

[Tropicals Magazine, Ichthyologica, July-August 1963]

In my column in the May-June 1963 issue of TROPICALS, I briefly mentioned the fact that the fish aquarists commonly refer to as *"Aphyosemion calliurum,"* *is* not really that fish at all. Early this year, the Danish Zoologist, Stenholt Clausen (of the Zoological Museum in Copenhagen), described this fish as a new species, viz., *Aphyosemion nigerianum* (pronounced, AF-EE-OH-**SEM**'-EE-ON NYE-JEER-EE-**AY**'-NUM). Unlike the true *calliurum* (which, by the way, has recently been imported into this country under the designation of "wild *australe*"*), nigerianum is* a member of the subgenus *Fundulopanchax (calliurum* belongs to the subgenus *Aphyosemion).* Contrary to the opinions of many hobbyists, *nigerianum* does not have subspecies. Both color varieties are frequently found even within the same pond or ditch! The variety that predominates in most localities in nature, however, is the one exhibiting yellow edgings on its anal and dorsal fins.

Along with his description of *Aphyosemion nigerianum,* Mr. Clausen introduces two additional new species in this genus. My following remarks will also be brief as the author's friend and distinguished aquarist, Col. J. J. Scheel of Denmark, is planning a rather comprehensive article on all of these fishes later this year. Readers are urged to consult this article when available, for details and further information.

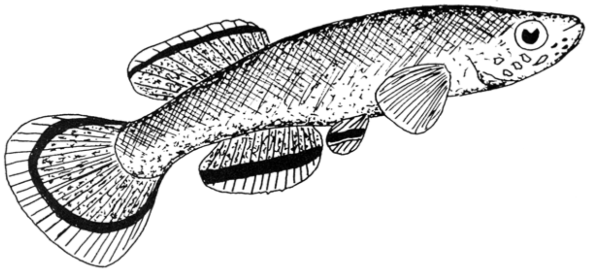
The second new species is another member of the *Fundulopanchax* subgenus and has been



TOP: Aphyosemion rubrifascium, male above, female below.
BOTTOM: Aphyosemion nigerianum (photo by author)

christened, *Aphyosemion cinnamomeum* (pronounced SIN-AH-**MOW**'-ME-UM). This beautiful fish was found in a small stream in Kumba, Cameroon, and it apparently breeds in a manner similar to that of *A. nigerianum.* The entire border of the male's caudal fin, as well as the lower border of the anal and ventral fins, is colored a bright yellow-gold. There are bright cinnamon (hence the name) elements throughout the fish and dark-violet is also present in quantity on the body. This fish is one of those aphyosemions sporting a rounded tailfin. Another peculiarity is that the males develop their coloration late in life and even after attaining sexual maturity, may be almost indistinguishable from females. This species undoubtedly is one of our most beautiful aphyosemions.

The third and last new species is this time, a member of the subgenus *Aphyosemion* (killie



***Aphyosemion cinnamomeum* Clausen**
(drawing by author)

fanciers will recall that Dr. Myers subdivided the genus *Aphyosemion* into three subgenera, viz., *Aphyosemion, Fundulopanchax,* and *Callopanchax.* This fish, *Aphyosemion rubrifascium* (pronounced, ROO-BRA-**FAS**'-SEE-UM), hails from the Cameroon Highlands in Africa, inhabiting the grasslands and savannas of that area. The males sport a number of thin, vertical, vermillion-colored bars (hence the origin of the name), standing out vividly against a background of metallic blue-green. The fins are streaked and spotted with red. Although its jaws are strongly developed, it is not as robustly built as, say, the familiar Blue Gularis. In some respects, *rubrifascium* resembles an *Epiplatys* (in shape of head, traverse bars, etc.) but it is much prettier than the average member of that genus.

Unfortunately, all specimens of *Aphyosemion rubrifascium* collected died before they could be transported to Denmark. *A. nigerianum,* however, is quite firmly established within the hobby and it is hoped that *A. cinnamomeum* will, via additional importations and egg-sendings, also find itself a favorite of killifish fanciers everywhere.

ACKNOWLEDGEMENT
The author wishes to thank Col. J. J. Scheel for his assistance in helping to bring this material to the attention of American aquarists.

Fertilization of *Corydoras* Solved!

[Tropicals Magazine, Ichthyologica, September-October 1963,]

More than once I have admitted of being a siluridophile (i.e., "catfish lover") and consequently, the recent series of articles in TROPICALS by Messrs. Dobkin and Cook [1,2,3] were of particular interest to me, especially in view of the fact that these articles were definitely superior to the overly generalized trash that is usually written about these fishes. The purpose of this short note is to clarify certain aspects of the breeding of *Corydoras* and once and for all to dispel any nonsense about so-called "mysteries" of the fertilization act.

In this author's opinion, the outstanding aquarium students of the genus *Corydoras* are: P. H. Stettler, the well-known Swiss aquarist; H. Pinter, a renowned Swedish aquarist; and J. Knaack, an inventive and resourceful German aquarist. These three authorities are agreed that the female does not deliberately carry sperm on her barbels [4,5,6] to the site where the eggs are ultimately fastened (the ridiculous suggestion that she swallows the sperm and later passes it through her vent will not even be considered here). Furthermore, there is no "mystery" whatsoever as to what does occur as shall shortly be demonstrated.

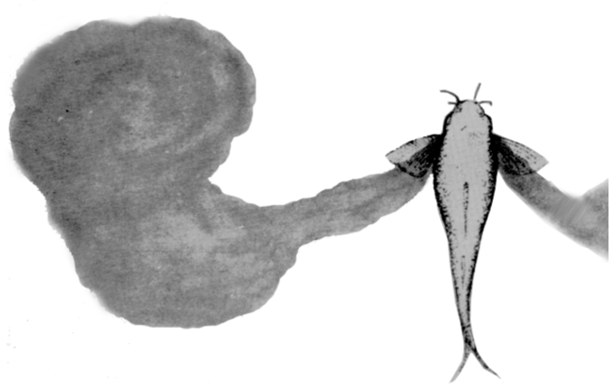


Figure 1: Non-spawning female *Corydoras*, showing path of dye (after Knaack)

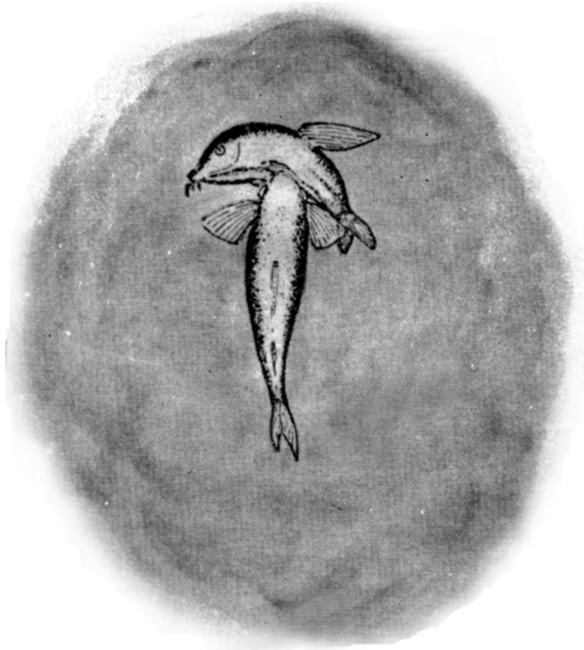


Figure 2:
Spawning pair of *Corydoras*, showing path of dye, i.e. sperm cloud (after Knaack).

In a series of brilliant experiments, Herr Knaack showed that the male fertilized the eggs of *Corydoras* in a rather prosaic way. Using a micropipette filled with a very concentrated solution of sodium fluoresce in (a fluorescent dye), a quantity of this dye was released in front of the mouth of a non-spawning female *Corydoras* (the pipette was hair-thin, almost invisible in the water… note that we are talking about very minute amounts of this dye because it is extremely powerful in its optical effect). Shortly afterwards, a yellowish-green cloud (the color of the dye when it comes in contact with water) emanated from each gill (see figure 1). This was to be expected as it followed the normal water path across the gills.

Now those who have bred *Corydoras* know that at one point during the spawning act, the male presents its ventral area to the female and the latter takes a position of from 30 to 90 degrees to this surface (not always the "T" formation, therefore, described in the literature). The female moves her barbels about the vent region of the male and it is this stimulation that excites the male to release his sperm. Often, the male clamps the female's barbels to his ventral surface by means of his pectoral fins. This fact has not been widely reported, yet careful documentation by photographs has proven this. The clamping act, however, does not occur every time.

Knaack repeated his experiment with a spawning pair. As it so frequently happens, fishes in the spawning act are difficult to disturb (some fish can even be stroked while spawning without disturbing them . . . cichlids, for example, often will ignore disturbances during spawning which at other times, would agitate them considerably) and Knaack had no difficulty in placing his pipette near the mouth of the female. This time, however, two separate clouds of dye were not observed but rather a single, spherical cloud that enveloped both fishes (see Figure 2). This was caused by the rapid gill movements of the female (much more rapid than normal) and the movements of the pectoral fins and bodies of both fishes. The experiment was repeated many times with the dye being placed in various locations. In every case, the spherical cloud was ob served enveloping the two fishes. Samples of the water in the cloud were examined under a microscope and were found to contain sperm. Knaack also discovered that *Corydoras* sperm was able to live for a much longer time than the sperm of other aquarium fishes with which he had experimented.

Thus, the fertilization picture in *Corydoras* can be summarized as follows. The female stimulates the male to release his sperm by her ventral contacts. Simultaneously, a few eggs are released by the female and received into a "pocket" formed by her ventral fins. By the concerted action of body, fin and gill movements, the sperm envelops the spawning pair, ensuring fertilization of the eggs. The fertilized eggs are then deposited on a pre-selected (and cleaned) site. At no time does the female "collect" sperm on her barbels or anywhere else on her body (the sperm is not sticky nor is it formed into a spermatophore as one finds in certain livebearers and also the swordtail characin).

As a postscript, it should be mentioned that I have tried the pipette-dye technique myself (also experimenting with other dyes) and have found it most effective. Patience is needed (as well as the proper equipment) but water currents and flows can be pinpointed quite nicely.

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Recent Developments in *Nothobranchius* Nomenclature

[Tropicals Magazine, November-December 1963, Ichthyologica]

In 1844, the pioneer colonist and specialist in African natural history, W. C. H. Peters, described what was to become our first known *Nothobranchius* species. When aquarists finally obtained specimens of this genus, they were overwhelmed with their beauty and since that time, they have remained high on the list of our most beautiful aquarium fishes.

Through the years, American aquarists have become quite familiar with four "nothos" in particular (although at least two other species have also been imported occasionally). These have been known to the hobby as follows: *Nothobranchius rachovii* (this is frequently misspelled with only one "i"), *N. "guentheri," N. "palmquisti,"* and *N. "melanospilus."* Recently, one additional notho has joined the list - *N. neumanni*. According to Dr. P. H. Greenwood of the British Museum (perhaps the leading authority on this genus in the world today), only two of these names are correctly used, viz., *Nothobranchius rachovii* and *N. neumanni*. The statement in a recently published book (*Exotic Tropical Fishes*) is in error when it synonomizes *N. rachovii* with *N. taeniopygus*, for the latter fish is a separate and distinct species closely related to *N. brieni* (perhaps conspecific). Aquarists are advised to totally disregard all of the notho nomenclature used in this book for, as we shall see, not a single name used is correct.

The first surprise to aquarists is that our so-called "*Nothobranchius melanospilus*" is really nothing more than the true *N. orthonotus. Nothobranchius orthonotus* is one of the most widely distributed East African killies and it has many color forms, so much so that a number of these forms have erroneously received separate species names over the years (e.g., *N. "melanospilus", N. mayeri, N. kuhntae,* and *N. troemneri*). These are, however, all forms of *N. orthonotus*.

The second surprise is that *N. "palmquisti*" and *N. "guentheri"* (as aquarists know them) are one and the same species! Dr. Greenwood has demonstrated this by morphological examination, comparison with the type specimens at the British Museum and by hybridization experiments. In addition, neither name is correctly applied to these two forms, for the true *N. guentheri* and *N. palmquisti* have not been imported into this country at the date of this writing. However, this picture may change in the near future. The true *guentheri* is a much larger fish although it is similar in color to our "false *guentheri.*"

What, then, is the correct name for these two forms we know so well? At the present, it is not possible to state an answer with certainty although there is a chance that the correct name might be *Nothobranchius microlepis*.

This does not end our problems re notho nomenclature. In fact, they are just beginning. However, it is important that aquarists recognize that the names, *"melanospilus," "guentheri*" and "*palmquisti,*" as used by them in the past, are not correctly applied.

ACKNOWLEDGMENTS

The author wishes to thank Dr. P. H. Greenwood, Barry Franz, Bruce Turner, and Dr. Satya Dubey for their kindness in assisting with this month's column.

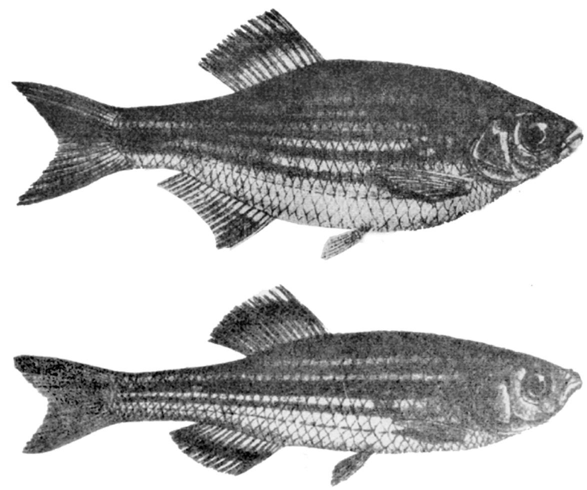
The Giant Danio

[Tropicals Magazine, Ichthyologica, January-February 1964,]

In 1909, a fish later to be known to aquarists as the "giant danio" was imported from India to Germany, and immediately became a great hit with hobbyists. To this day, it still continues as a perennial favorite both here and abroad. The scientific name attached to this fish was I, a name used by almost all aquarium reference books even today.

Danio malabaricus was described by Jerdon in 1849, its range being given as the western coast of India and Ceylon. Before this, however, another *Danio* had been described, viz., *Danio aequipinnatus*, by McClelland in 1838. Its range included the Himalayas at Darjeeling, the whole of the Assam district to Tenasserum in Burma, and south to the Deccan district of India where it met *D. malabaricus*. Its range, therefore, was east and north of its sister species.

Drawings of both fishes (see figures), however, show something interesting. Whereas *D.*



***Top: Danio malabaricus* (after Day)**
Bottom: *Danio aequipinnatus* (after Day)

malabaricus is an extremely deep-bodied fish, *D. aequipinnatus* is not. If aquarists were to choose between them for the scientific name of the giant danio, they most assuredly would select the name, *D. aequipinnatus*.

In 1941, Drs. Hora and Nair (specialists in Indian fishes) did, in fact, synonomize *D. strigilifer* and *D. malabaricus* with *D. aequipinnatus*. The correct name of the giant danio as far as aquarists are concerned is, therefore, *Danio aequipinnatus*. It is not to be denied that there is still some scientific discussion, however, about these fishes. One ichthyologist maintains that *aequipinnatus* and *malabaricus* are even possibly subgenerically distinct, let alone being valid species! However, if these two fishes are distinct species then almost certainly our aquarium specimens are either hybrids or of *aequipinnatus* origin.

In spite of the fact that things are not settled yet, no ichthyologist is willing to say that the common aquarium "*malabaricus*" should bear that name although there are a number who are ready to say that it should not. In view of the fact that no matter what the outcome of the scientific discussion it is extremely unlikely that our fish is the true *malabaricus* (if such a thing exists), it is suggested therefore that aquarists use the name, *Danio aequipinnatus*, in all instances.

Rafinesque to you, too!

[Tropicals Magazine, Ichthyologica, March-April 1964]

Browsing around in what most aquarists would consider to be the relatively musty corners of ichthyology is a rather rewarding experience for me personally. It kind of offers a change of pace from the wrinkled fingertips one usually obtains as a consequence of long immersion in water (carefully aged, that is!). For example, what's the longest scientific fish name? Well, the record name, and one still in use today, is *Microstomatichthyoborus bashforddeani*! Rather dryly, the famous American ichthyologist, David Starr Jordan, commented: "It is hoped that no one will attempt to break this record"… Amen!

Quite frequently I encounter amusing incidents revolving about eminent scientific personalities that deserve a chuckle now and then. The ichthyologist, Carlo Bonaparte, once thought to name a fish in honor of the ichthyologist, Cocco, and came up with the monstrosity, *Ichthyococcus*! It sounded more like a fish disease than the name of a fish! The great British ichthyologist, Guenther, understandably was a bit miffed at this, reflecting that such names have "always been considered as a nuisance." Consequently, he changed the name to the more reasonable, *Coccia*, but unfortunately, according to the Rules of Nomenclature, *Ichthyococcus*, still stands today as its correct name.

But now we come to perhaps the strangest and most hilarious story in the whole of ichthyology. Without doubt, one of the most fascinating characters in its history was Constantine Samuel Rafinesque-Schmaltz (his last name later written simply as Rafinesque). At this point, readers may think that I am pulling their legs but I assure everyone that the following account is "gospel!" Rafinesque named many fishes, among them a number of aquarium species as well, e.g., *Fundulus notatus*. He was an eccentric, wanderer-naturalist, and self-styled linguist who, after a brief sojourn in America, moved to Sicily. However, he finally settled in the United States and actively collected many objects of natural history from fishes to plants. Therefore, we may claim Rafinesque as our "own."

Now when I state that Prof. Rafinesque was a "character," I mean to imply that it should really be spelled with a capital "C." So great was his zeal for naming new things that he claimed to have discovered and given names to 12 species of lightning and thunder on the headwaters of the Ohio River! Rafinesque had a predilection for inventing many nonsense generic names of peculiar sound and spelling. In fishes, for example, here are several illustrations: *Onus, Stizostedion, Ilictis* and *Atractosteus*! Nevertheless, as a consequence of being one of the first ichthyologists to study two of the world's richest fish faunas, that of Sicily and that of the Ohio River, he was an important ichthyologist. David Starr Jordan had this to say of him: "His various papers show his peculiar traits, intense activity, keen philosophical insight, and hopeless slovenliness in method."

And now we come to the story of perhaps the greatest joke in l history. Rafinesque was an acquaintance of the great ornithologist and painter of birds, Audubon, and in 1818, he found himself a guest at Audubon's home at Hendersonville, Kentucky. Now, Audubon's own personal formula for relaxing was to play the violin and he owned quite an expensive instrument. Unfortunately for the great ornithologist, the violin happened to be kept in the room occupied by Rafinesque. One night, bats entered the window and Rafinesque was convinced immediately that they were a new species. Needing something with which to club them down, Rafinesque seized Audubon's prized violin and proceeded to capture his specimens and demolish the instrument in the process.

To say that Audubon was annoyed when he learned what happened to his violin is an understatement and he vowed revenge. Thereupon, he sat down and painted several mythical fishes, showing them to Rafinesque with the comment that they were seen by him, "down by the river." Rafinesque, of course, was delighted and promptly wrote a paper entitled, "Further Discoveries in Natural History." In this paper he described three new genera, viz., *Pogostoma, Dinectus* and *Litholepis*. The last-named genus literally means, "stone-scaled" and was given by Rafinesque after Audubon told him that the fish in question was known locally as the "devil-jack diamond fish," the scales of which would "turn a rifle ball!" Rafinesque was the object of several additional "l jokes," all of which were dutifully written up in the scientific literature, a process which took several years. It is not recorded what Rafinesque said when he learned about Audubon's jokes, but for a family-type magazine such as TROPICALS it is probably just as well!

The Guppy and the Molly Change Names!

[Tropicals Magazine, Ichthyologica, May-June 1964]

The family Poeciliidae, containing the majority of aquarium livebearers, is divided into 3 subfamilies, 21 genera and 138 species as a result of a substantial revision of all prior classifications recently completed by Drs. Donn E. Rosen and Reeve M. Bailey (see reference). This revision is of considerable importance to aquarists insofar as nomenclature is concerned for it significantly alters the names of some quite familiar fishes, notably the mollies and the guppy (among others).

Now although it may very well be true that there are no hard and fast objective rules for naming genera, there are certainly some very practical considerations. When an ichthyologist emphasizes the sundry minute points of difference that exist among fishes, it is hardly surprising that he will tend to identify numerous genera, becoming what is known in taxonomy (i.e., the art of classifying animals according to their "natural relationships") as a "splitter." For example, one ichthyologist placed two intimately related species into two different genera merely because one of them possessed an asymmetrical gonopodium.

However, the modern view is that the genus can and should serve to express relationships. As we learn more about a group of fishes, we are able to sort out better those differences, which are important, and those, which are not. Consequently, with increased knowledge, the tendency is towards larger genera, not smaller ones. It is in this light then, that Drs. Rosen and Bailey have "sunk" a considerable number of generic names of some old aquarium inhabitants.

This new classification (of the entire family) is shown in Table I. Subfamily names end in -inae and tribes in -ini. Of immediate importance, however, is the genus *Poecilia* (pronounced, PEE-**SIL'**-EE-AH), which is further split into four subgenera.

SUBGENUS *Poecilia*: This subgenus contains an old aquarium fish, *Poecilia vivipara*, its name unchanged. However, it also contains most fishes formerly in the genus *Mollienesia*. These fishes now become, e.g., *Poecilia sphenops, Poecilia latipinna, Poecilia velifera*, etc. Of course, this will not affect the use of the popular term, "molly."

SUBGENUS *Lebistes*: This subgenus contains fishes with a high degree of color difference between male and female. It contains mostly fishes formerly belonging to *Lebistes* and *Micropoecilia*. Thus, the guppy now becomes *Poecilia reticulata* and aquarists should note that there is also a slight change in the ending of the trivial portion of the name (i.e., "a" instead of "us") so that it agrees in gender with *Poecilia* (which is feminine). The fishes formerly in *Micropoecilia* become *Poecilia parae, Poecilia branneri*, etc.

SUBGENUS *Pamphorichthys*: This sub-genus at present is of little importance to aquarists so no more will be said about it here.

SUBGENUS *Limia*: Here we have mostly fishes formerly placed in *Limia*. These now become *Poecilia vittata, Poecilia nigrofasciata, Poecilia ornata*, etc.

The new classification will require some getting used to but it makes infinitely much more sense. For example, the so-called "guppy x molly" cross is now readily understood since both fishes now are of the same genus. For the aquarist, this new classification will enable him to recognize differences and similarities between related fishes that are worthy of additional study. The possibilities in new crossings within Poecilia alone are fascinating to contemplate.

ACKNOWLEDGMENT

The author wishes to thank Dr. Donn E. Rosen, of the American Museum of Natural History, for his kind assistance in bringing to the attention of aquarists, these important name changes.

REFERENCE

Rosen, D.E. and R. M. Bailey, "The Poeciliid Fishes (Cyprinodontiformes), Their Structure, Zoogeography and Systematics," Bulletin of the American Museum of Natural History, Vol. 126, Article 1, pgs. 1-176, 1963.

CLASSIFICATION OF THE POECILIIDAE
(after Rosen & Bailey)

TOMEURINAE
- **Tomeurus**

POECILIINAE
- **Poecilini**
  - ***Alfaro***
  - ***Poecilia***
  - ***Priapella***
  - ***Xiphophorus***
- **Cnesterodontini**
  - ***Phallotorynus***
  - ***Phalloceros***
  - ***Phalloptychus***
  - ***Cnesterodon***
- **Gambusiini**
  - ***Brachyrhaphis***
  - ***Gambusia***
  - ***Belonesox***
- **Girardinini**
  - ***Girardinus***
  - ***Quintana***
  - ***Carlhubbsia***
- **Heterandriini**
  - ***Priapichthys***
  - ***Neoheterandria***
  - ***Heterandria***
  - ***Poeciliopsis***
  - ***Phallichthys***

XENODEXIINAE
- ***Xenodexia***

On the Status of *Corydoras*

[Tropicals Magazine, Ichthyologica, July-August 1964]

I must admit that it came as a complete surprise to me to learn that the familiar generic name, *Corydoras,* is on a very shaky taxonomic standing indeed. Since this issue of TROPICALS contains my companion piece devoted to the family Callichthyidae, it seems appropriate to discuss the term *Corydoras* in this month's .

Corydoras was erected by the famous ichthyologist, Lacepede, in the year 1803, solely to accommodate one *Corydoras geoffroy.* Unfortunately, Lacepede provided no drawing of the fish in his description or locality information, and furthermore, the type specimen has long since been lost. Had the fish been adequately described, the latter would pose no great problem for one could petition the International Commission on Zoological Nomenclature for permission to name a "neotype" (a preserved fish designated to replace a lost or missing original specimen upon which the fish was described). However, Lacepede made many errors in describing this fish (e.g., he stated that it had no barbels, certainly a contradiction of what we know about all *Corydoras* species). In fact, the great French l team of Cuvier and Valenciennes suggested that Lacepede might never have removed the fish from the bottle to describe it! Suspicious also is the high dorsal fin counts given (i.e., 9). What it all boils down to is that although the fish definitely was a callichthyid, it is impossible now to place it either generically or specifically.

The question now arises, "Should *Corydoras* be discarded because it is unrecognizable?" The answer to this is that many early descriptions of fishes are currently unrecognizable and that it would do the science of ichthyology great harm were such designations changed at this late date.

But let us continue with the history of *Corydoras geoffroy.* In 1840, Cuvier and Valenciennes equated *Corydoras geoffroy* with the 1794 species of Bloch, *Cataphractus punctatus,* a species now placed in *Corydoras.* This action was accepted by later authors. Does this now identify *Corydoras geoffroy?* No, guess again! Unfortunately, no recently known species can be equated with certainty to Bloch's *punctatus.* Eigenmann's *punctatus* of 1912 actually is a composite of *melanistius* and *potaroensis.* As for the aquarium "*punctatus"* of today, what aquarists don't know is that this is a synonym for either *melanistius* or *potaroensis.* Since ichthyologists can't identify *punctatus,* how can aquarists? Nor is *the* "*punctatus"* of Arnold & Ahl (in their classic aquarium text, "Fremdländische Süsswasserfische," published in 1936 … the German equivalent of Innes' "Exotic Aquarium Fishes") really Bloch's fish either … it most likely is *Corydoras melanistius.*

Yes, old time ichthyologists were sometimes notoriously careless with their descriptions and consequently, we really do not know the fish upon which the genus *Corydoras* was based. For the sake of stability, however, no one dares rock the boat and *Corydoras* it remains.

Plecostomus vs. *Hypostomus*

[Tropicals Magazine, Ichthyologica, September-October 1964,]

In 1763, Lorenz Theodor Gronow published a work in which although the genera of fishes were well defined, the species had polynomial designations. This work was published before the author had become acquainted with the binomial system of Linnaeus (The tenth edition of *System Naturae*, published in 1758). Most of Gronow's names were "rescued" by Johann Scopoli in 1777 (*Introductio ad Historiam Naturalem*) as the latter published the names correctly with regard to Linnaean nomenclature. Unfortunately, several of Gronow's generic names were not accepted by Scopoli and one in particular is of interest to aquarists, viz., *Plecostomus*.

What did Gronow do wrong? In describing *Plecostomus*, for example, he wrote, "*Plecostomus dorso dipterygio*." This is merely a polynomial phrase that, to some extent, literally describes the fish (it means, "fish with a folded mouth and two dorsal fins" . . . the "two dorsal fins" refers to the large dorsal fin plus the adipose fin). The fish in question was named (1758) by Linnaeus as "*Loricaria* *plecostomus*," but Gronow was unaware of this. Be that as it may (we are not really concerned with species now anyway), the term "*Plecostomus*" became widely used. Even today, it is used by aquarists and writers on aquarium topics almost as a matter of course.

There has been a great deal of controversy in the scientific community over whether or not the genera of Gronow (i.e., those not saved by Scopoli) should be accepted. In Opinion 20, the International Commission of Zoological Nomenclature did indeed state that Gronow's genera were to be accepted. The famous American ichthyologist, David Starr Jordan, however, dissented saying, "The eligibility of the generic names of Gronow is questioned as not conforming to the Linnaean code in the terminology of species."

What has been generally overlooked, however, is that subsequently the Commission reversed itself and in Opinion 89, it suspended the rules and declared, "… the following works or papers are declared eliminated from consideration as respects their systematic names as of their respective dates: Gronow, 1763 …" Since the latest International Code of Zoological Nomenclature (XV International Congress of Zoology) did not revoke any previous decision of the Commission on a particular name or work, *Plecostomus* is indeed, as dead as the proverbial doornail.

What, then, is the correct name to use? The answer is *Hypostomus* (pronounced, HY-**POS'**-TA-MUS, meaning "mouth underneath"), erected by Lacepede in 1803. Since Gronow's name is invalidated, the first valid name following him is the one to use and this is *Hypostomus*. It has been argued that Walbaum validated Gronow's *Plecostomus* with the publication in 1792 of his *Artedi Piscium*, but this is virtually a restatement of Artedi's pre-Linnaean work (with the exception of one genus), and in the case of *Plecostomus*, the same work as used by Gronow initially. Thus, *Hypostomus* is the only valid name.

Advising Customers On Proper Mixing Of Fish

[Pet Shop Management, April 1963]

Some years ago, a problem arose in a local aquarium society concerning the most effective way to recruit new members. One obvious solution was to distribute club publicity brochures via fish stores. But it soon became apparent that many of these brochures simply were being ignored. In stores especially sympathetic to the membership campaign, owners encouraged customers to take a brochure. It was understandable, of course, that most owners could not take time away from the more serious business of managing their stores.

Then an idea that was subsequently adopted was suggested. Since the club was primarily interested in recruiting newcomers to the hobby, and because a major problem for the beginner is deciding upon the proper "mix" for his initial tank, a single (8-1/2 inches by 11 inches) mimeographed sheet was prepared, suggesting combinations of fishes for selected sizes of aquaria. The club message appeared at the bottom of the sheet.

This time the handouts went like hotcakes and, as a matter of fact, storeowners began using them to assist their own customers in stocking their community tanks. To this day, a similar handout still is used in many of these stores.

When a customer asks, "What fishes and how many of each can I put into my tank?" the an-

	GLASSFISH	BLOODFIN	BLUE GULARIS	CLOWN BARB	TIGER BARB	ANGELFISH	SPOTTED DANIO	MALE BETTA	MOSQUITO FISH	CORYDORAS CATFISH
GLASSFISH	C	C	C	NR	C	C	C	C	C	C
BLOODFIN		C	C	NR	C	C	C	C	C	C
BLUE GULARIS			C	C	C	NR	C	C	NC	C
CLOWN BARB				C	C	NR	NR	C	NC	C
TIGER BARB					C	NR	C	C	NR	C
ANGELFISH						C	C	C	NR	C
SPOTTED DANIO							C	C	C	C
MALE BETTA								NR	NR	C
MOSQUITO FISH									C	C
CORYDORAS CATFISH										C

C = COMPATIBLE, NC = NOT COMPATIBLE, NR = NOT RECOMMENDED

Suggested Fish Population for a Standard 5-gallon Tank

2 lemon tetras	2 head-and-taillight tetras
2 pearl danios	2 white clouds
2 zebra danios	2 neon tetras
2 glowlight tetras	2 tetra von Rios
2 cherry barbs	1 *Corydoras* catfish

swer invariably is either incomplete or far too time consuming. By the time a dealer has rattled off a list of names (most of which are not familiar to the customer anyway), the customer has forgotten most of those at the beginning of the list. If the dealer is pressed for time, he may easily omit favorable combinations.

One dealer I know gives the customer a list, pencil, and an invitation to browse about the store and check off fishes that are of greatest interest to him. The customer is invited to add fish not already on the list. The customer's selections then are reviewed by the dealer and additions to the list are evaluated as to compatibility with other selected fishes, tank capacity, and other factors. Other dealers merely use the list as a starting point for the customer to study.

Such lists are inexpensive and can be revised when new fishes arrive on the scene. For example, a Plecostomus may be replaced by a Siamese algae eater.
There is an added advantage to these lists in that they may be taken home by the customer, and, as a result, keep the fish store prominent in the customer's mind.
Lists may be of two kinds:

(a) Suggested populations of fishes for a given tank size.
(b) Table of compatibilities of fishes.

The second type offers the customer wide selection, while the first solves compatibility and capacity problems simultaneously. Examples of both types are given.

These lists do not eliminate the need for the wise counsel of the store's staff. They are, however, valuable aids and time savers in dealing with customers who are setting up a community tank for the first time.

Should Tanks Have Plants?

[Pet Shop Management, October 1963]

If there is one single thing that distinguishes a dealer's tank from one belonging to a hobbyist, it is the perennial presence of an elbow in the former. Attached to the elbow, of course, is an arm, a hand, and a net.
Yes, the dealer is forever dipping into his tanks as a consequence of the fundamental lemma of fish retailing, i.e., "Before you sell 'em, you've got to catch 'em." The hobbyist, on the other hand, relieved of the necessity for such physical assaults upon his own aquaria, sanctimoniously leans back and makes disparaging remarks about the clarity of those of the dealer.

Many dealers make an attempt to set up all of their stock tanks with plants and gravel. But fish are notoriously uncooperative during the capture and such tanks are almost impossible to maintain at their best. It has been done, however, but two factors have been shown to improve the chances for success:
(a) Smaller-sized aquaria.
(b) Under-populated aquaria.

Smaller sizes make capturing easier, and under-populating reduces the amount of natural debris that accumulates on the bottom, debris which is easily stirred up to produce a cloudy tank. Strong filtration produces, of course, results equivalent to under-populating. It may be argued that such a system represents considerable work but there is no doubt that there are many occasions when it is a practical system to which the well-known Fish Bowl, in Irvington, N.J., attests.

My personal observations, however, indicate that this system is at its worst when a large number of fish are sold from a given tank. If business in fish is brisk, then this system is not recommended. On the other hand, for those stores establishing a reputation for rare, hard-to-obtain fish, and specializing in relatively low volume, high quality-high price stock, this system deserves consideration.

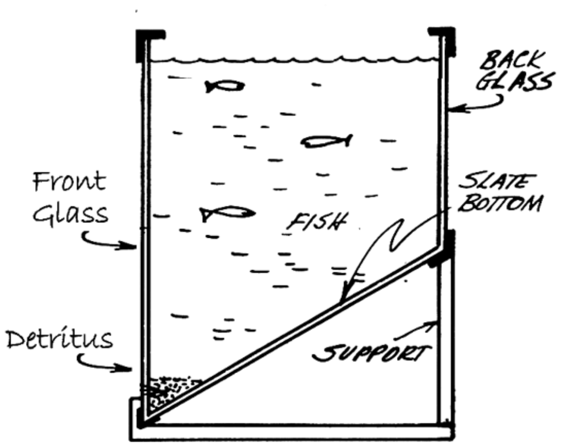


FIGURE 1

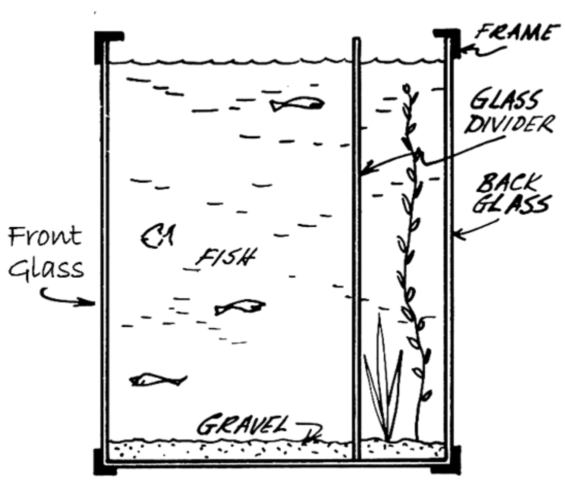


FIGURE 2

By far and away, however, the vast majority of retailers use either bare tanks or tanks so devoid of plants that they might as well be termed bare. The latter practice produces a particularly messy-looking tank. These are the tanks that give dealers the reputation of "cloudy water," "unclean tanks," etc. Undoubtedly, the dealer should either fish or cut bait for this is a bad compromise, indeed.

Perfectly bare tanks, on the other hand, are easy to keep clean and they indicate more quickly, when cleaning needs to be done. They are highly recommended for high-volume stores. An outstanding example of this system is the Aquarium Stock Company's New York City store. Here, the fish are moved rapidly from any given tank. Specially constructed tanks (see Figure 1) aid in their housekeeping. Plants are kept in tanks of their own.

When bare tanks are used, it is important to maintain a number of fully planted, completely stocked display tanks. These are the tanks the customer will remember and try to emulate. Although the bare tanks may not be esthetically appealing, the display tanks will be the ones upon which the dealer can establish a portion of his reputation.

A word of caution, however. Many dealers set up such purely-display tanks and then promptly place a sign on them reading, "Fish And Plants In This Tank Not For Sale." This is a mistake of the highest order. It is difficult to find anything else that will cause as much resentment against the dealer. This practice places the dealer in direct competition with his customers and can only lead to ill will.

It is realized, of course, that the motivation for this policy is to prevent the reduction of the display to a cloudy mess. However, there are better ways to avoid this, e.g., merely by placing a fairly high (but not unreasonably high) price on every item in the display tank.

Enclosing Tanks - Pros, Cons

[Pet Shop Management, November 1963]

Traditionally, retail stores have staged their stock tanks on metal or wooden stands in the open (frequently tiered), but many dealers utilize enclosures of one kind or another. The most simple kind is nothing more than paneling containing cutouts, behind which the tanks are set, each aquarium appearing then in a picture frame-like setting.

The overall effect is quite beautiful and it conveys an impression of neatness. The picture frame setting enhances the natural attractiveness of fish and plants, suggesting similar ideas to the customer for his own home decor. Furthermore, enclosure prevents unwanted access to the tanks themselves, a problem in some stores (some thoughtless customers even drown their cigarette stubs in dealer's aquaria!). There are, however, attendant problems to this kind of staging.

It will not be denied, of course, that enclosing is more expensive, although the stands that support the tanks as well as the filters, lights, etc., used are not seen by the customers and considerable economies in these items may be effected. One need not, for example, use expensive lumber or paint the stands (assuming wood is used, rather than metal)

I prefer wood over metal for staging since wood is more easily worked or altered, lends more stability to structures, and does not conduct electricity (and there are invariably many electric wires about!), or rust. Because the enclosure paneling is vertical, setback tiering is not possible.

One can only have levels of aquaria set one above each other.

The biggest problem is access to the tanks. This is accomplished by entry from in front or behind the paneling. Entry from in front means that a door (or doors) must be set in the paneling above each tank. When the customer selects a fish, the dealer opens the doors, reaches in, and nets out the fish.

The problem here is that the best position ("best" in the sense that the fish and plants look their best) for a tank light is at the front of the aquarium. Here, however, it interferes with access to the tank unless some mechanical provision is made for sliding it back - another nuisance. In addition, access to filters, airlines, etc., is more difficult from the front.

An alternate is rear access. This means that space must be provided between wall and tanks to enable the dealer to walk behind them. In a store where space it at a premium, rear access is precluded and front access must be used instead. Rear access provides easy access to filters and other equipment and affords convenient storage space for nets, containers, and other paraphernalia that tend to suggest clutter if they are stored within sight of the customer. Tank lights also can be placed near the front of the tank without having to be moved when netting fishes.

Aside from the bother of additional walking to get behind the tanks, rear access has the disadvantages that the customer has more difficulty in pointing out the fish he wants than when front access is used. To partially overcome this, background panels may be constructed of wood or metal, and hung on the rear of the aquarium via two or more clips that hook over the rear edge. The dealer then removes the background panel before netting the fish, permitting customer and dealer to see each other and facilitate selection of the fish.

In general, if the business is a high-volume operation, enclosing is not a good idea. Quite a bit of time is consumed in obtaining access to enclosed tanks, particularly the rear access type. And if space is limited, rear access is not advisable at all.

If volume permits, however, enclosed tanks are without doubt, the most effective way to display fish or plants.

Margins As Pricing Devices

[Pet Shop Management, May 1963]

Perhaps the most popular means of pricing in retail business firms is the use of margins, or markups. The price of any item is determined by adding a margin to the article's wholesale cost, as follows:

Price (P) = Wholesale Cost (W) + Margin (M) or $P = W + M$

The question then arises, what is the margin practice consistent with maximum profits? A popular policy is to maintain a constant relative margin (where relative margin = M/P), no matter what the wholesale cost. However, it can be shown that this behavior implies that the demand curve for the item (a demand curve is a plot of the price of the item vs. the quality of the item sold) has a very special shape.

Let us make the following simplifying assumptions:

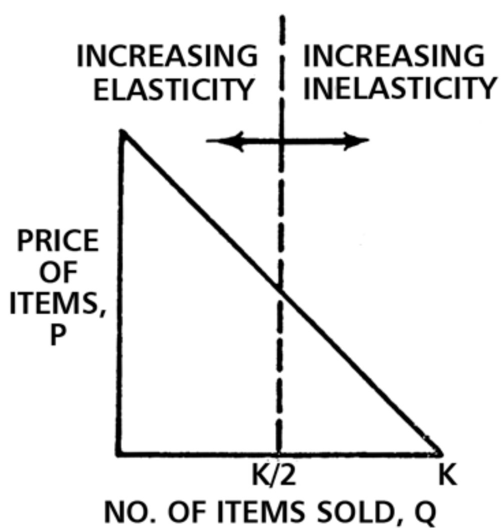
(1) At any given time the firm can buy any amount of the item at the same wholesale price.
(2) The firm prefers more total profits to less.

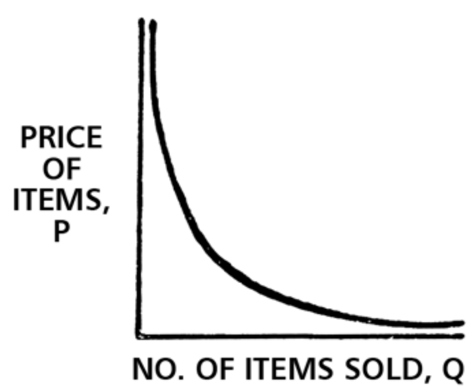
From this, any good economist - without going into details here - can derive the following relationship at maximum total profits:

$$M/P = - 1/E$$

where E is the elasticity of the product, economically speaking, or more specifically, the ratio of the relative change in quantity sold, divided by the relative change in price. Elasticities are always negative, or zero if we give away the item. Hence, the reason for the negative sign in the relative margin equation.
For those a bit confused by the symbolic explanation of elasticity, let us consider it in another way. An inelastic product is one in which an increase in price results in lower total revenues. Examples would be as follows:

INELASTIC: Salt (we wouldn't decrease our consumption of salt very much even if the price doubled).
ELASTIC: Color TV Sets (a change in price would decidedly affect sales).





It is obvious from experience that inexpensive "bread-and-butter" fishes such as guppies, mollies, neon tetras, etc., are more inelastic than expensive fishes such as scats, discus, monodacs, etc. Note, however, that dealers unconsciously recognize this because their relative margins decidedly differ between these two groups of fishes. The relative margin of the bread-and-butter fishes is quite high, usually somewhere between 3 and 6 (or expressed as a percentage, between 300 and 600 per cent). The relative margin on rare fishes is usually much lower, between 100 and 200 percent. This is consistent with our relationship,

$M/P = - 1/E$

for the greater E is, the lower must be 1 M/P.

The unfortunate thing is that dealers do not follow through in hard goods what they practice in livestock. All too often they set a constant relative margin on pumps, tanks, reflectors, stands, etc. If one assumed that E was constant for these items, then this would be consistent with our formula and would provide a maximum profit. Experience suggests that these elasticities are not constant, however.

Illustrated are two extreme types of demand curves. Curve I is a linear demand curve, one characteristic of which is that the elasticity is not the same at any two places on the curve. Curve II is a hyperbolic curve, characterized by a constant elasticity (either inelastic or elastic) throughout. Most demand curves fall between these two extremes.

As an example of an application, if management feels that elasticity increases with price for a given demand curve confronting the firm (in the left-hand portion of Curve II, for example), the management should let the relative margin vary inversely with the level of the wholesale cost.

The purpose of this article is to warn of the dangers of blind policy in maintaining constant relative margins without good cause. It has served its purpose, if dealers re-evaluate their own policy in this regard.

The Difference in Aquarium Filters

[Pet Shop Management, March 1963]

It is the rare retailer who is in a position to stock everything that his customers may demand at one time or another, and the fish store proprietor is no exception.

There is a right way and a wrong way to explain this simple fact to one's customers but before we say a few words on this, let's briefly investigate the quality aspects of inventory problems. One interesting aspect is that frequently there may be little or no difference in cost to the dealer between well-designed aquarium products and badly designed ones. We are talking now about competitive lines and not comparisons among inexpensive, moderate, and high-priced lines.

To cite some examples, let's consider filters for the moment.

One can easily line up a half-dozen filters side by side, all competitive price-wise with each other, and quickly pick out those designed by "engineers" whose closest approach to fish has been with tomato sauce and a dash of lemon on top. Stocking items is not a simple matter since price, advertising, competition and other influences complicate the picture, but should these factors remain substantially the same for different substitutive products then the dealer should institute his own private consumer's research and choose items best designed for the purpose at hand.

Inside filters are, for example, bound to be wet when taken out to be cleaned. Many such filters are so designed that it is extremely difficult to pull the top off for cleaning. There is at least one model in which a hefty pull is needed and when the top suddenly decides to part company with the rest of the filter, the resulting application of Newton's Third Law of Motion (Action Equals Reaction!) has the charcoal and the filter fiber thrown all over the floor.

Another filter is designed so that a piece that ordinarily receives rough handling in normal cleaning is fastened to the body of the filter by a thin, plastic tab. Invariably, the tab breaks off after a short time, making repairs necessary. And due to the construction, repairs don't last long either.

If a dealer goes through this evaluation process, discarding the poor designs in favor of the good ones, it seems idiotic to bury this information, so far as the customer is concerned.

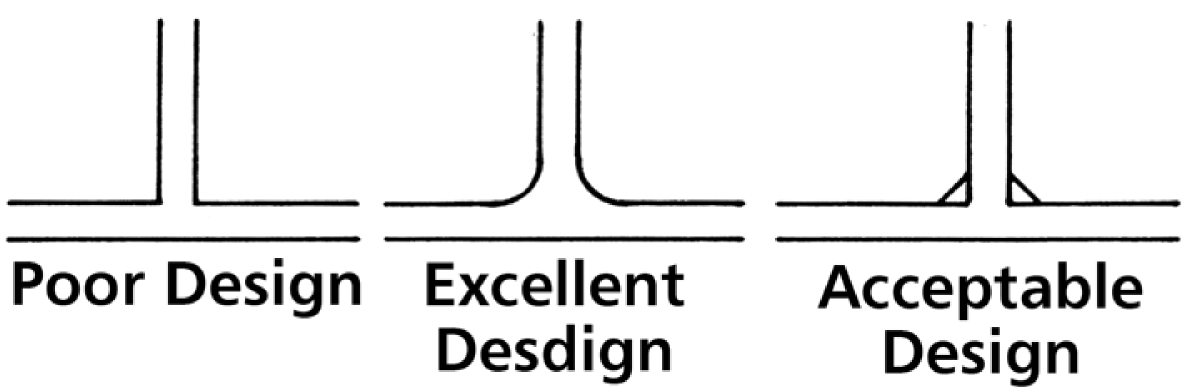
An all too common response to the customer who asks for an item that is not stocked is, "We don't carry that item, but here is something better." Many customers just don't buy this sort of answer (or the merchandise). How much better it would be to keep a number of reject items on hand and demonstrate their defects, contrasting them with the well-designed item you do stock. It's as simple as gluing these products to a length of plastic so the exhibit will be stable enough for you to spend your time pointing out the pros and cons of the equipment being compared.

For competitive reasons you might well stock a cheap item, but it should be pointed out that price is the reason for this, not necessarily good design or high quality. A truthful statement like this might very well convince a customer to graduate to a superior product.

Although my experience has been, in general, that the higher the price of the article, the better the quality of materials used (there are exceptions), this statement does not necessarily hold for design. Good design and quality materials are two different things.
Let's consider one more example.

In cleaning inside filters, aquarists sooner or later have to resort to some vigorous rubbing to remove the firmly adhering brown algae that so often are encountered inside these filters after they have been in service awhile. Some filters have unnecessary ridges and protrusions (I am not speaking now of vital structural parts but of "gingerbread" design added for the sake of appearance) that interferes with the cleaning (rubbing) process, leaving pockets of dirt behind. However, the quality of materials used in the filter may be quite high … the defect is in design only.

Customers have a great deal of respect for dealers who know their business. Nothing as



quickly demonstrates a dealer's competence than familiarity with the machinery of the hobby, plus the ability to make sensible evaluations in the process.

The Importance of Tank Sizes

[Pet shop Management, June 1963]

More than one dealer has found pride in his newly equipped store with its row after row of neat tanks, all of identical size. Something may be said for this overall impression of order, but such an arrangement is inherently inflexible and has a number of disadvantages.

The obvious disadvantage is gleaned from the tank order, for it is apparent that different fishes are usually ordered in different lot sizes. Neons, angels, swordtails, etc., are usually ordered in quantities of 100 or more, while this is not customary with killifishes, elephant fishes, scats, discus, and other rarities. If only large-sized tanks are used, species must be mixed and the mixing usually creates problems in itself. What suits one fish doesn't necessarily suit another. This not only applies to housing, but to feeding as well. There is an understandable tendency on the part of dealers to standardize upon feeding routines. Should there be fishes requiring more specialized attention, they are less likely to receive it if they are scattered about in tanks with less demanding fishes.

It is also true that it is more difficult to sell a "bread-and-butter" fish when there are few of them in a tank. Customers are impressed by displays showing schools or a concentration of fishes. When only a few dozen remain in a large tank they are more difficult to move. If a smaller tank were available, however, they could be transferred and again would present a complete picture, instead of "the remains of a defeated army." Several years ago, I knew a dealer who placed a spawn of several hundred pearl gouramies in an 85-gallon tank. The fish sold at first like the proverbial hotcakes, but the last dozen or so stayed like the man who came to dinner.

This, of course, is not particularly a plea for smaller tanks per se, but rather for groups of aquaria standardized by size within each group. The groups need not be physically separated either. At least one dealer alternates 20 and 10-gallon tanks. However, they are built into paneled racks. Such an arrangement would not be feasible with open racks. Also, one should not forget that small tanks are harder to maintain than large tanks and, for the dealer, maintenance is always a problem.

There is an interesting sidelight to a customer's reluctance to purchase fish from a depleted tank. The old supermarket trick of putting all the loose ends into one basket, with a "Take Your Pick . . . 25 cents each" label, works in fish stores as well — even with somewhat higher prices! The important thing to remember is to keep the tank filled with fish. One dealer I know keeps his customers buying by seeing that there always is a fair population of fishes in his "Take Your Pick" tank. Interestingly, his prices of fishes in this tank aren't any lower than normal.

What sizes should the dealer's tanks be? I have seen stores with a preponderance of 10-gallon aquaria, and those with a major concentration of 40-gallon tanks. These are extremes, though.

The basic dealer's tank appears to be about 20-gallons, varying from 15-gallons in the smaller stores to about 29-gallons in the larger stores. In any case, however, it is better to use three or four standard sizes, with one or more very large tanks for display or large fishes. The balance to be attained, with maintenance considerations, involves the flexibility afforded by different sizes of aquaria, and the simplicity of fewer sizes. It is the rare store where these goals are not compromised.

Fish Tanks and Human Disease

[Pet Shop Management, February 1964]

In the Dec. 21, 1962 issue of TIME MAGAZINE, the general public was made aware of a new disease infecting humans and for which an aquarium served as the carrier of the disease.

Moreover, although the disease itself is relatively inconsequential, it is related to the dread human tuberculosis bacillus, further adding to the unfavorable publicity that cannot do our hobby any good and, indeed, may do it considerable harm.

There is no doubt that in some fishes, bacilli have been found which are closely related to the tuberculosis bacillus, *Mycobacterium tuberculosis,* of warm-blooded animals, including humans. In fact, there is considerable evidence to show that such diseases of fishes are not particularly rare occurrences either. Species of mycobacteria have been shown to cause fish illnesses with the following symptoms: wasting away, increased appetite, nodules under the skin, bloody spots in the skin, milky clouding of the skin, popeye, open wounds, and fin disintegration (especially at the outermost portions of the soft rays). Internally, nodules on various organs and necrosis in general are symptoms.

For the past 20 years, numerous reports were received of granulomatous skin lesions in humans following abrasions received in swimming pool accidents. In 1954, the causative agent was identified by Linell and Nordan and described as a new species, *Mycobacterium balnei.* In time, the conditions came to be known as "swimming pool granuloma" (a granuloma is a localized collection of granulation tissues occurring in certain chronic infections, such as tuberculosis and syphilis). The name may have to be changed to "fish tank finger" as a consequence of the discovery of *M. balnei* in a tropical fish tank, resulting in two human infections subsequently. This marks the first time a mycobacterium has been shown to infect bath man and fish, although we shall mention the most recent discovery, which adds still another.

In November of 1961, a 37-year old woman proprietor of a pet shop cut a finger on the top frame of one of her fish tanks. The cut appeared to be clean and apparently healed quickly. Four weeks later, however, nodules developed about this hand, some of which were pea-sized. The woman experienced little discomfort from the lesions but they were inconvenient, esthetically speaking, and occasional ruptures and discharges occurred from the lesions. These lesions oozed a sticky fluid for a few hours, and then a scab formed.

Three weeks later, her son (age 18) also cut his finger on this same tank frame, and similar symptoms developed. The mother reacted positively to the tuberculin tests and a subsequent culture at room temperature showed numerous mycobacteria, clearly pigmented yellow. Agglutination studies showed this bacterium to be M. *balnei.*

Later on, swabs from the sides of the tank grew M. *balnei* even though the tank had been emptied and cleaned by the family! Water from the tank also yielded positive cultures although other tanks in the store did not. The family was instructed to either destroy the tank or immerse it in a strong bactericide. Treatment was ineffectual. The patients, including swimming pool victims, have not improved when given antibiotics or anti-tuberculosis therapy. Fortunately, the lesions disappear by themselves, but this takes a matter of several months. One of the odd things is the question of why *Mycobacterium balnei* granulomas aren't more common throughout the hobby, especially in view of the fact that the organism is widespread throughout the world.

Aquaria actually serve as ideal culture bowls since recirculation is usually a feature, and the temperatures used are near optimum (about 75° F). However, the usual laboratory procedure does not include culturing media at normal room temperature (it is usually done at human body temperature), so that the organism could easily miss being identified. Then, too, since the consequences of the disease are not catastrophic, and since it is essentially self-healing, many cases may never come to the attention of doctors.

However, the latest research, accomplished by Drs. Ross Nigrelli and Henry Vogel at the New York Aquarium, has shown that tuberculosis in fishes is more prevalent than is generally suspected. The disease has been found in 151 species of fishes! In the New York Aquarium alone, tuberculosis was present in 40 species of fishes, especially in the tropical fresh water forms belonging to the characins, cyprinids, and livebearers. Most important, however, is the fact that a bacillus isolated from the neon tetra *(Hyphessobrycon innesi)* is identical with *Mycobacterium fortuitum,* a human pathogen! This disease was first isolated from human and cattle lesions in South America. Fortunately again, for humans (and especially aquarists and fish dealers), both *Mycobacterium balnei* and *fortuitum* incubate at about 75 degrees F. and not at 98.6 degrees F., therefore being impossible to incubate internally in humans.

The important thing to remember is that a fish tank has served as a vector of human diseases and others may be discovered in the future.

It would be a most sensible course of action to treat cuts with care when one is attending to one's hobby or livelihood, as in the case of the dealer. Furthermore, it would be well for dealers to properly familiarize themselves with the facts as outlined, in order to properly meet such situations themselves and to advise their customers if the need arises.

Dealers, Veteran Aquarists Need Better Relationship

[Pet Shop Management, April 1964]

Often it is heard that the fish dealer depends for his livelihood upon either the new or the casual aquarist, but not upon the experienced one. "Yes," says one dealer, "I can sell a complete outfit to the beginner … tank, stand, pump, filter, fish, plants, etc., but if I sell food to the old timer, then I consider that par for the course."

There undoubtedly is a good deal of truth to this statement. In some respects, the fish hobby is like the photographic hobby; there is a good deal of what might be called "capital equipment" in which to invest. The camera and the enlarger are expensive items for the photographer and must be purchased at the start. So are the tank, stand, and pump of the aquarist. Subsequent purchases by both groups may not be as substantial.

Experienced aquarists frequently are allied with aquarium societies, or be-long to informal coteries that serve the same purpose. Consequently, there is a good deal of trading within these groups. Since such groups actually may increase the fish and plant population within a given area, there may be a self-perpetuity about the process that makes them even more independent of the dealer.

But the point now is, does the dealer ignore such groups or individuals?

In these days of keen competition, it seems almost suicidal, business wise, for any dealer to ignore even the last two or three percent of a possible market. It might easily be the difference between red or black ink at the end of the year. Many times it has been observed that the more successful shops are those in which experienced aquarists have the most faith. Speaking as an experienced aquarist, I have known that, aside from regular large purchases of frozen food's and occasional purchases of rather expensive fishes and plants, my total on the local dealer's cash register may not be overly impressive.

After all, my tanks, filters, pumps, etc., have long since been bought and paid for. However, I know for a fact that such relationships go much deeper than just the superficial economic view. Many times, for example, dealers ask me to comment upon new items of equipment or new preparations. Also, I frequently am invited to identify this or that fish and plant. Furthermore, I meet many newcomers to the hobby who want to know the name of a "goad" fish store.

Naturally enough, I direct them to those retailers I consider fair and competent. They are not sent to cut-rate outfits. What the beginner really needs is truly competent help and assistance. Cheap equipment without this expert guidance may prove to be very expensive indeed.

It is amazing how much word-of-mouth free advertising goes to people from experienced aquarists who themselves might not be characterized as "heavy spenders." I have a very good friend in the Chicago area who owns and operates a rather small fish store ... nothing fancy and nothing spectacular in the way of unusual fishes or plants. Yet, it is without hesitation that I recommend his shop to those who ask about such a store, for I know that the advice given will be sound and will provide the fledgling aquarist with a solid foundation for the future enjoyment of his hobby.

Many storeowners view the experienced aquarist as one who pushes homemade equipment and who is given to do-it-yourself projects. In part this is true, for one can seldom go to a fish store for a 10-foot, 2 by 4 rack, or a 175-gallon aquarium. But really experienced aquarists long ago reached the conclusion that junk is junk, and not worth the price.

My friends and I, for example, recommend standard stainless steel tanks, standard filters and pumps, and - except for large holding containers and custom lighting and staging installations - use nothing else but basically standard equipment.

There is much to be explored in the dealer-experienced hobbyist relationship, but only if both understand each other. Both can survive without the other, it is true, but it is a sorry survival. Both can help each other, but only if "know-it-all" attitudes are eliminated on both sides. Dealers are in a position to help the experienced hobbyist in the acquisition of new plants and fishes, and many experienced aquarists are in a position to assist the dealer in sundry technical matters and in improving services.

It may be that dealers are faced with aloof, experienced aquarists - but we are writing for dealers now, and urge them to break the proverbial ice first.

Heating

[Pet shop Management, August 1966]

The problem of heating a large number of aquaria must be resolved within two extremes; heating each tank individually, and providing heat to all tanks simultaneously from some central source. The hobbyist ordinarily selects the former, the dealer the latter. This is understandable as central heating is relatively expensive to install for the hobbyist, and the individual tank units are rather inefficient for the dealer unless only a few tanks are being considered.

Whether the dealer heats tanks individually or not, some sort of central heating must be in use, if only to keep the customer from freezing! The problem, however, is that ordinary heating in older buildings is often inadequate. The constant opening and closing of the door as customers enter and leave, poses heat loss problems. Another difficulty found in improperly engineered systems is in the adequate distribution of heat. Often, tanks located near the floor are considerably cooler than those located higher up. Even if the temperatures involved were suitable for fish, one cannot transfer either fish or water from one elevation to the other under these circumstances, without subjecting the fish to thermal shock. Therefore, one of the prime considerations is to insure proper circulation of heat. If heating units are installed at ceiling level (as so many gas space heaters are), they should be supplied with louvers and a fan to direct their heat properly. Hot water heating should be installed with the pipe at the floor level, as heat rises.

Three Kinds of Heat Loss

Tanks lose heat through conduction (i.e., loss of heat through the glass by physical contact with the air), radiation (i.e., loss of heat through infrared radiation) and evaporation (i. e., loss of heat as a direct result of the heat needed to evaporate water). However, the prime source of heat loss is through conduction. If we can keep the air warm, the tanks will stay warm also. Many dealers make the mistake of maintaining a hothouse environment, which is extremely uncomfortable for their customers. There is no need to maintain water temperatures over 75°F, of course, but the prime source of discomfort is the high humidity so common to dealer installations. If ventilation is adequate, this will be no problem. A good fan system is an integral part of a good heating system for the dealer, even if hot water heating is used (a point often overlooked with such systems).

Heaters are usually sized in terms of BTU (British Thermal Unit) capacity per hour. Each material of construction has a particular heat loss coefficient which is measured in the rather formidable unit of BTU/hour/ square feet/ °F temperature difference. Examples of these coefficients are given in Table I.

How to Calculate Heat Loss

The calculations necessary to s' heater are as follows (see Table II). Measure the area of windows, area of doors, area of walls (this is the total area of wall minus area of windows and doors), area of ceiling and area of floor. For each of these areas, select the proper heat coefficient from Table I and enter it in the third column in Table II. Under the "Air

TABLE I

ITEM	COEFFICIENT
Single-strength window glass	1.0
Double-strength window glass	0.5
Plate glass	0.7
Door, half-glass	0.8
Door, all-wood	0.5
Wall, brick, single	0.5
Wall, brick, double	0.4
Wall, brick, single and plastered	0.4
Wall, brick, double and plastered	0.3
Wall, concrete, 2 inches	0.7
Wall, concrete, 4 inches	0.6
Ceiling	0.3
Insulated ceiling	0.2
Floor, wood on joists	0.3
Floor, concrete	0.3

TABLE II			
ITEM	**AREA, SQ. FT.**	**COEF-FICIENT**	**BTU's**
Windows	48	1.0	48.0
Doors	36	0.8	28.8
Walls	460	0.5	230.0
Ceilings	280	0.3	84.0
Floor	280	0.3	84.0
Air change	2240	0.02	44.8
		Total	519.6

Change" factor, take as the area the cubic feet of the room in question and always 0.02 times the number of air changes per hour in the room (usually taken as one per hour) as the heat coefficient. Enter the measured areas mentioned previously in their correct positions in the second column of Table II. Now multiply the area column by the heat coefficient column to obtain the BTU column. The total of the BTU column is the total BTU's required for a 10F difference between outside and inside temperatures.

Table II shows the calculation required for a typical 14 foot by 20 foot room, resulting in a 520 BTU/hour/ °F total. Suppose the minimum outside temperature is 25°F and we desire to maintain a temperature of 75''F inside. This is a 50°F temperature difference. Multiply this figure by the BTU total (i.e., 520 x 50 equals 26,000) and this will give you the BTU/hour load for the room. Your heater should be sized accordingly.

Determine Heat Input

Since 3.415 BTU's equal one kilowatt, one can easily see that if electricity is to be used, it should be put into the tanks, not into the room. To calculate individual tank losses, measure the area of the walls and the bottom of the tank. For a one foot by one foot by three-foot tank, this totals 11 square feet. To this figure add 1.5 times the water surface area (the surface area of this example tank is three feet so, our grand total is 11 plus 1.5 x 3 or 15.5). This figure represents the heat loss for a 1°F temperature difference per hour. If we desire, for example, the tank to be kept at 75°F and the room temperature is 60°F, then the total BTU's required per hour are 15.5(75 — 60) = 232.5. Recall that one watt is 3.415 BTU's, and we find that a heater of at least 232.5/3.415 = 68 watts is needed (a 68-watt heater would, of course, operate continuously under these conditions).

These calculations are approximate as there are many factors that may mitigate any particular situation (insulation, for example). However, they are conservative and will serve as a useful guide to the planning of any heating installation, new or remodeled.

Some People Believe Walking Catfish Are Dangerous - They Bite Dogs!

[Pet shop Management, October 1968]

In the August 23, 1968 issue of TIME magazine there appeared an article entitled, "Fish Bites Dog" - and my neighbor promptly panicked. The thought of a 2-foot fish scuttling across lawns at night and attacking dogs was just too much for her!

The culprit is apparently the albino form of *Clarias batrachus*, an Asian catfish of the family Clariidae that has enjoyed a modicum of popularity with aquarists who delight in keeping "oddball" fishes. The clariid catfishes are of great interest to both hobbyists and ichthyologists alike as they have, in addition to gills, accessory breathing organs that enable them to breath atmospheric air. Indeed, their gills are relatively small and in some cases appear inadequate to sustain life; such fish that are prevented from reaching the surface of an aquarium soon die.

If kept out of water, *Clarias* suffers no inconvenience provided its respiratory apparatus remains moist. Sometimes the fish voluntarily leaves the water, presumably in search of better living or feeding conditions, or perhaps to escape enemies. Certainly aquarists are familiar with this propensity to leave its tanks and must take care that aquarium covers are well secured.

Its movements on land suggest swimming and can properly be described as wriggling, hence their native name of "pia duk dam" ("dull-colored wriggling fish"). Hugh M. Smith tells of a friend who brought him a specimen of *Clarias batrachus* that was picked up on a metal driveway in his yard in Bangkok. The fish had left a small canal 50 feet away and was proceeding towards another canal 110 feet away! It was placed in a jar of water in Smith's office but during the night, it jumped from the jar, dropped from a table to the floor, passed through a short corridor, traversed a large exhibit room, went the entire length of a long hallway, and was found in a lively condition just inside the front door at 11 pm. J. B. Welman described a mass migration over dry land of a shoal of *Clarias* (most likely *C. mossambicus*) in Nigeria. The shoal appeared to be on its way from water, which was drying out, to more permanent water.

In 1967, the first wild albino *Clarias batrachus* incidents were reported from Florida, all from Palm Beach County (in particular, the Lake Worth Drainage District in the eastern part of the County). Several were caught on hook and line, using worms as bait; others were collected by dip net. One specimen, about 10 inches long (the species reaches about 16 inches in length on the average, with some individuals growing larger), was found by a night watchman on dry land some one-half mile from water! As the TIME article further put it: "There are even some far-out reports that it has attacked curious dogs sniffing at it." The truth of the matter is that the only dog a *Clarias* will attack is a hot dog but that, of course, is not "news."

The Florida Game and Fresh Water Fish Commission recently completed a preliminary investigation of this introduction to native waters, their conclusions being stated as follows: "A potentially dangerous Clariid catfish has been introduced into South Florida. Although young fish have not been found, the high incidence and wide distribution of collected adults tends to indicate that an established population exists. The usual barriers (salt water, control structures, levees, etc.), which confine or control the movements of fresh water fishes do not apply to the family Clariidae. A fish with the ability and inclination to leave the water and 'walk' around is, to the best of our knowledge, unmanageable. The individual or individuals responsible for introducing the Clarias catfish may have done the people of Florida a great disservice. It is quite probable that the Clariids may have a more detrimental effect on the ecology of Florida than any other group of fishes including the piranhas."

One of the authors of the report, Vernon E. Ogilvie, appeared on National television (i.e., the Johnny Carson Show) on September 4, 1968, at which time he exhibited several of these fish. This was followed the next day with an appearance on the Dick Cavett TV Show.

One of the recommendations of the Florida report is a ban on all members of the family Clariidae. This is rather typical of reports produced by similar State agencies, i.e., if one species is the "culprit," ban the whole family. Because carp are a problem in California, that State once sought to ban all cyprinids, which, of course, includes goldfish, barbs, rasboras, and danios, among others. Only by concerted action and vigorous protest on the parts of hobbyists and members of the pet industry was this idiocy averted. Although the Florida report generally was well researched, it was marred in parts by some sensationalism (e.g., it overstated the aggressiveness of the fish - the report made a point of the fact that their specimens terrorized piranhas - and erroneously gave the impression that *Clarias* were dangerous to human beings as well). The effect on the public understandably was tremendous. The writer had a difficult time explaining to his neighbor, for example, that practically any fish can terrify a piranha (a normally timid fish) under suitable conditions, and that both she and her dog were perfectly safe and not likely to be devoured!

We are currently in an age when imported animals, especially fishes, are being subjected to restrictions and bans never before witnessed in the history of this country. These actions are sought by fish and game officials to prevent real or imagined damage to our ecosystems. The problem arises from accidental or deliberate release of fishes (in the case of these animals) into public waters. The writer has considerable sympathy with the fears of the conservationists in this matter and has encouraged fish farms and hatcheries to ensure against accidental release of exotic fishes, and has roundly condemned any deliberate release. It is about time that hobbyists were alerted to the facts and that the pet industry enters into educational programs for this purpose.

On the other hand, the enthusiasm of public officials sometimes leads to outright abuses. The banning of the aruana in Texas, and the neon tetra in California (since rescinded) are examples of such absurdities. The pet industry should well remember that “the price of liberty is eternal vigilance,” and be prepared to counter the many pointless and irrational proposals that seem to run rampant among those who believe that the perfect world can be obtained simply by creating more laws, rules, regulations and bureaus.

Marketing Pets and Supplies - The Freshwater Aquarium Department

[Pet Shop Management, September 1969]

AREAS OF CONSIDERATION

Tanks - 10 or 15-gallon capacity is optimum size for the beginner. Smaller or larger tanks are best maintained by experienced hobbyists - tanks larger than 30 gallons, hobbyist should have at least six months experience; tanks smaller than 10 gallons, at least 12 months experience. Recommend standard stainless steel frame models for all tanks under 50 gallons. Those over 50 gallons can be made of 1/2 or 3/4 inch exterior plywood - all joints screwed and glued; interior painted with epoxy paint.

Stands - staging stands for all tanks can be purchased ready-made of angle iron. Staging for less than 30 gallons can be constructed of two by three inch lumber; 30 to 50 gallon tanks use two by four inch lumber.

Filters/Pumps - general filter types include the inside box, outside box, undergravel and power. The power filter is ideal for beginners – the outside box is second choice. More experienced hobbyists are suited for inside box and undergravel types. Except for undergravel, filters use “floss” - usually nylon - and granular charcoal. Power filters need no special pump - all other filters require a pump. If filtration is supplied, aeration is not needed. Aeration is useful in clearing water, removing some chemicals used in treatment of diseases - especially dyes - and in breeding some fishes such as barbs, danios, and tetras. Also useful in hatching some fish eggs, particularly cichlids.

Heaters - recommended procedure is to use one thermostatic-heater combination per tank. Rule of thumb is three to five watts per gallon of tank capacity. For fish rooms, electric space heating is very costly - gas heating is most economical.

Aquascaping - gravel - 1/16 inch diameter - on bottom; depth unimportant but should be sloped on an irregular basis from front to back to allow dirt to accumulate in front where it can be easily removed. Rule of thumb is two pounds of gravel per gallon capacity of tank. Tanks under 10 gallons that are used as holding or breeding tanks should have bare bottoms. Wood is excellent, but use only driftwood or well-soaked wood. Not green wood. Wood can be cured by boiling in saltwater. Rocks are excellent but avoid lime-bearing specimens such as limestone.

Lighting - incandescent produces best effect, but concentrates light in small areas and encourages growth of algae and is very hot. Best fluorescent color is "warm white" - avoid "daylight" type. Gro-Lux provides exaggeration of blue and red colors in fish, rocks, etc. Rule of thumb: incandescent - 7-1/2 watts per gallon burning eight hours per day; fluorescent - 1-1/2 watts per gallon burning eight hours per day. For natural daylight, best placing of tank is on either side of a window in an east wall.

Water - General-purpose water should be moderate in hardness and neutral in pH - 100 to 200 ppm hardness, 6.8 to 7.2 pH. Generally, livebearers will endure harder, more alkaline water. Egg layers can stand softer, more acid water. Tap water may contain chlorine, excess oxygen, or bacteria. Allow tap water to stand a minimum of three days in open container before using. Up to one quarter of a tank of water can be changed every two to four weeks, using the aged water described above, to reduce buildup of chemicals from feeding, metabolism, etc.

Plants - can be artificial or real. Good beginner's plants are Amazon swordplants, *Hygrophila* and *Vallisneria*. Other excellent specimens include the cryptocorynes, *ambulia*, water wisteria, and *Sagittaria*. Avoid *Anacharis, Cabomba,* and *Myriophyllum* as these are primarily for coldwater tanks - goldfish, orfe, etc. Do not bury the crown of the plant in gravel. Use potting soil only for specimen plants such as the aponogetons, and then only if pot is actually used. Allow for the fact that some plants require more light than others - Amazon swordplants need more light than do cryptocorynes. For the sake of the aquascaping, do not place "center" plants in the center of the tank!

Diseases - either external or internal. The latter are difficult to treat and almost impossible to cure. Fortunately they are rare. *Ichthyophthirius* - Ick - appears as white spots or nodules on body and fins. It is very contagious and occurs on almost all types of fish. Treatment consists of using commercial remedies containing dyes such as malachite green. Cure takes about one week. *Oodinium* – Velvet - appears as tiny rust colored spots over body and fin - looks like gold to orange dusting. It is very contagious. Killifishes, bettas, and white clouds especially susceptible to this disease. Treatment consists of commercial remedies containing copper. Cure takes approximately four to six days. Fungus appears as a cottony growth on body and fins. Only mildly contagious. Treatment consists of commercial remedies containing colloidal silver. Cure takes approximately one week. Fish often develop fungus or other growths on body or fins after wounded accidentally or in a fight. The treatment for wounds usually consists of holding the fish firmly in a soft net, swabbing the affected area with a Q-Tip soaked in mercurochrome. Repeat twice a day.

Under unfavorable conditions, fish may fall prey to a host of maladies. Symptoms of disease include folded fins, wasting away of the body, clouded eyes, puffiness of body, erratic swimming, listlessness, etc. If such conditions are epidemic, recheck the important principles of fishkeeping. The two classes of drugs useful in combating these miscellaneous diseases are sulfur drugs and the broad-based antibiotics such as aureomycin, chloromycetin, etc. Both types are available commercially.

Feeding - two very important types of food available are frozen brine shrimp, tubifex, etc. and dry flake. Fish will thrive if fed both types as a matter of course. The aquarist may supplement these with live foods such as daphnia, mosquito larvae, bloodworms, white worms, micro worms, etc., plus grated frozen beef heart. Rule of thumb is to never feed food larger in size than the eye of the fish. For baby fish and fry, egg yolk, infusoria, powdered dry foods, and newly hatched brine shrimp are usually indicated. For the tiniest fry, such as those of bubblenest builders, only the first two may be used for the first seven to 10 days of life.

Aquarium Fish - the general groups of aquarium fish include tetras, barbs and danios, livebearers, cichlids, bubblenest builders, killifishes and catfishes. Aquarists generally lump the remainder under the term “oddballs.” Beginners should start out with tetras, barbs, danios, and catfishes. Livebearers and bubble nesters can be added next. Cichlids - with the exception of angelfishes - and killifishes are for the more experienced hobbyist only. A pair of each of the following will suffice for a 10 gallon tank: zebra danios, cherry barbs, *Corydoras* catfish, *Barbus oligolepis*, neon or cardinal tetras, black tetras, lemon tetras, sunset variatus platies, head-and-taillight tetras, and rummynose tetras. Tiger barbs, blue gouramies, and male swordtails occasionally bully other fishes or nip fins. Angelfish and pearl gouramies are shy fishes with long extensions to their ventral fins. They should have places of concealment in their tank - plant thickets - and should never be mixed with fin nippers such as tiger barbs, or robust, fast moving types such as blown barbs.

Important Principles - do not overfeed; small but frequent feedings are better than one large feeding. Signs of overfeeding are blackened gravel, cloudy and/or smelly water. Do not overcrowd. Rule of thumb for stocking ordinary sized fish is not to exceed two inches of total fish population per gallon of water. Symptom of over-crowding is fish coming to the surface to gulp air. Do not change conditions abruptly. Never change water temperature suddenly - a fast change of five degrees F. downward is dangerous. Never change pH suddenly - an abrupt change of hardness of over 50 ppm or pH of over 0.5 points is dangerous. Fish laying on side near bottom or going into convulsions are signs of shock.

Identification Of Kribensis-Like Species

[Aquarium Illustrated, January-February 1966. Note: This article was co-authored with Richard F. Stratton, AJK being the Senior Author.]

Since 1952, American aquarists have had access to several species of the African cichlid genus *Pelmatochromis,* the best known of which perhaps being *Pelmatochromis kribensis. Pelmatochromis kribensis* belongs to a complex of species, all closely related and similar in appearance, which may be termed the *"subocellatus group."* The problem has been that at least three members of this group have been imported into the United States since that date and consequently, aquarists have been quite puzzled over the correct names to assign to them. Basically, there are 4 species in the group: *P. subocellatus* (from the Congo), *P. pulcher* (from Nigeria), P. *taeniatus* (from Ghana to Nigeria) and P. *kribensis* (from Nigeria to the Cameroons). A very few key counts and measurements for these species are shown in TABLE I. On the basis of these counts and measurements alone, they are very difficult to separate, indeed.

In recent times, the first to be imported was *Pelmatochromis kribensis* (1952). At first this fish was mistakenly called *Pelmatochromis taeniatus* (mostly in Germany) but this error was quickly corrected. During the early 1960's, two additional species were imported. One, from the Congo, was identified as *Pelmatochromis subocellatus;* the other, from Nigeria, remained without a scientific designation. On the east coast the latter was referred to as the "giant kribensis" or "Nigerian kribensis";

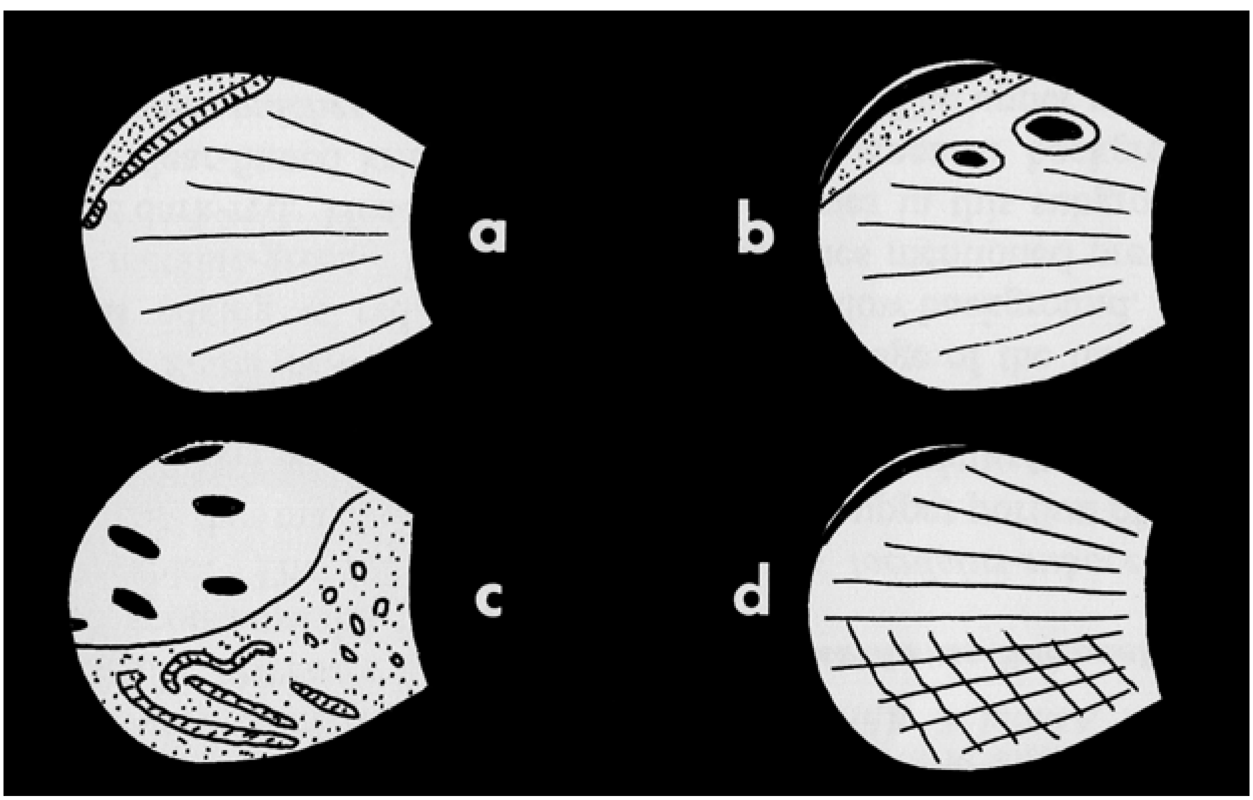


TABLE I				
	SUBOCELLATUS	KRIBENSIS	PULCHER	TAENIATUS
SCALES, LONG,	25-28	27-29	27-29	2929
DORSAL	XIV-XVI 8-10	XVI-XVII 8-9	XVI 9-10	XVII-VIII 7-8
ANAL	III 6-7	III 6-7	III 7-8	III 7
LATERAL LINE	15-18/5-9	18-20/5-9	18-20/8-10	19-21/7-9
TEETH ROWS	2-3	2	4-5	2-3
TEETH SIZE	small	outer row large	large	small

on the west coast it received the name, "clear-finned kribensis." A number of specimens of all 3 species were examined in detail, the counts, and measurements of which are also shown in TABLE I. A study of TABLE I, among other considerations such as coloration, pattern, and origin, leads to the following conclusions:

(1) Aquarium kribensis agrees fairly well with the original description of *Pelmatochromis kribensis.* Any minor discrepancies can be attributed to the now-known fairly wide range of this species.

(2) Aquarium subocellatus agrees very well with the original description of *Pelmatochromis subocellatus.* There is little doubt, as in the preceding species, that this fish is correctly identified.

(3) Our "clear-finned kribensis" agrees very well with the original description of *Pelmatochromis pulcher.* It appears that this is the correct name for this fish.

Aquarium Identification

As far as aquarium identification of the 4 species mentioned is concerned, we may divide them into two subgroups: *kribensis-pulcher,* and *taeniatus-subocellatus.* The *kribensis-pulcher* subgroup may be differentiated from the other by virtue of the fact that in both species, the lower half of the tail fin of the male is clear; in the *taeniatus-subocellatus* subgroup, the lower half of the male's tail fin sports numerous bowed stripes, roughly following the contour of the rear edge of the fin (see FIGURE 1).

Turning our attention now to the *kribensis-pulcher* subgroup, we note that *Pelmatochromis pulcher* is by far the larger of the two (indeed, it is the largest of all of the four species mentioned). Further, it is more colorful and tends to display more copper or gold

TABLE II				
	AQUARIUM SUBOCELLATUS	AQUARIUM KRIBENSIS	CLEAR-FIN KRIBENSIS	KLUGEI KRIBENSIS
SCALES, LONG.	24-25	26	27-28	2930
DORSAL	XIV-XVI 9	XVI 9	XVI 10	XVII-XIX 7-8
ANAL	III 6-8	III 7	III 8	III 7
LATERAL LINE	1618/7	18-20/8-10	I9/10	19-0/7-8
TEETH ROWS	2	2	4	2
TEETH SIZE	small	outer row large	Large	?

markings than does *kribensis.* It is difficult to generalize about the prominent dark spots in the upper portion of the tail fin of the male *kribensis* since the number of such spots may vary from 0 to 9! However, typically *kribensis* has from 1 to 3 such spots, usually bordered in yellow or gold. The upper, oblique rear edge of the male's tail is frequently edged in dark-brown to blue or black, then submargined in red or orange. In *Pelmatochromis pulcher* males, this edging is red, the submargin a metallic-green. Further, its fin rays are dark-red. Hence, the popular term "clear-finned kribensis" for *Pelmatochromis pulcher* refers to the absence of dark spots, not to any suggestion that its fins are really "clear." Since to our knowledge P. *pulcher* has never been figured previously in an aquarium publication, a photograph of a pair is shown in FIGURE 2.

Taeniatus-Subocellatus

In the *taeniatus-subocellatus* subgroup, the upper portion of the tail fin of the male *taeniatus* typically has from 5 to 9 dark spots, some running into the upper edge of the fin, set into an orange-yellow background. The dark, bowed lines mentioned previously for both species in this subgroup are set against a greenish background (see FIGURE 1). The upper portion of the tail fin of the male *subocellatus is* lacking completely in the dark spots characteristic for *taeniatus.* There is, however, a dark edging to the upper portion of this fin in the male *subocellatus.* The bowed lines in the lower portion of the fin are quite faint, however. The fish shown in the photographs accompanying the article, *"Pelmatochromis taeniatus",* which appeared in the AQUARIUM JOURNAL*,* Vol. XXXVI, No. 4, pgs. 172-176, April 1965, are not *taeniatus* at all; they are *Pelmatochromis subocellatus.* Of all the species considered so far, *Pelmatochromis subocellatus* is by far the smallest. One cannot mention *subocellatus* without some reference to the female in spawning coloration. During spawning, the body of the female *subocellatus* is divided into three sections by vertical lines as if a draftsman had done the job. The first or head section is jet-black; the mid-section is a deep violet from belly clear up into the dorsal fin; the rear section is jet-black. Sometimes, the violet of the mid-section approaches a chalk-white coloration (see FIGURE 3).

Hoedeman's Work

In 1954 and later, in 1956, J. J. Hoedeman, the well-known Dutch aquarist and ichthyologist, advocated treating *pulcher, kribensis* and *subocellatus* as subspecies of *Pelmatochromis subocellatus,* thus causing some confusion as *kribensis* then were sometimes referred to as *"Pelmatochromis subocellatus kribensis"* or simply as *"Pelmatochromis subocellatus".* To this action we cannot subscribe. An examination of his work indicates that Hoedeman never saw either *pulcher* or *subocellatus,* but rather a series of variations upon *kribensis,* variations that are quite familiar to aquarists breeding these fishes. This is not to say that they are not close, however. The authors have succeeded in hatching out fry of a cross between *kribensis* and *subocellatus.*

In DATZ*,* Vol. 18, No. 3, pgs. 70-73, March 1965, Hermann Meinken described a new Ghanaian fish as *"Pelmatochromis kribensis klugei."* From counts and measurements (see TABLE I) presented in an earlier paper *(DATZ,* Vol. 13, No. 11, pgs. 357-358, December 1960), we are convinced that this "subspecies" is but a Ghanaian form of *Pelmatochromis taeniatus.* Since neither *"klugei"* nor *taeniatus* has been imported into the United States in any quantity to this date, the question must remain somewhat academic. In any event, surely the *subocellatus* group is a brilliant assemblage of fishes and those aquarists who have appreciated the beauty of *Pelmatochromis kribensis,* will appreciate even more the greater beauty of its close relatives.

White Cloud Mystery Solved!

[Aquarium Illustrated, September-October 1966]

A Chinese proverb states: "The longest journey starts with but a single step", and accordingly, the first in our story was taken in 1932 by the Chinese ichthyologist, Shu-yen Lin, who described a new cyprinid fish, *Tanichthys albonubes* from White Cloud Mountain in Canton, China. As simple as this statement might seem, it was but a prelude to some considerable confusion that has only just been cleared up by Dr. Stanley Weitzman and Lai Yee Chan ("Identification and relationships of *Tanichthys albonubes* and *Aphyocypris pooni*, two cyprinid fishes from South China and Hong Kong", COPEIA, No. 2, pgs. 285-301, 1966). The following account serves as a case history to explain why, to the regret of aquarist and professional alike, names must be changed upon occasion.

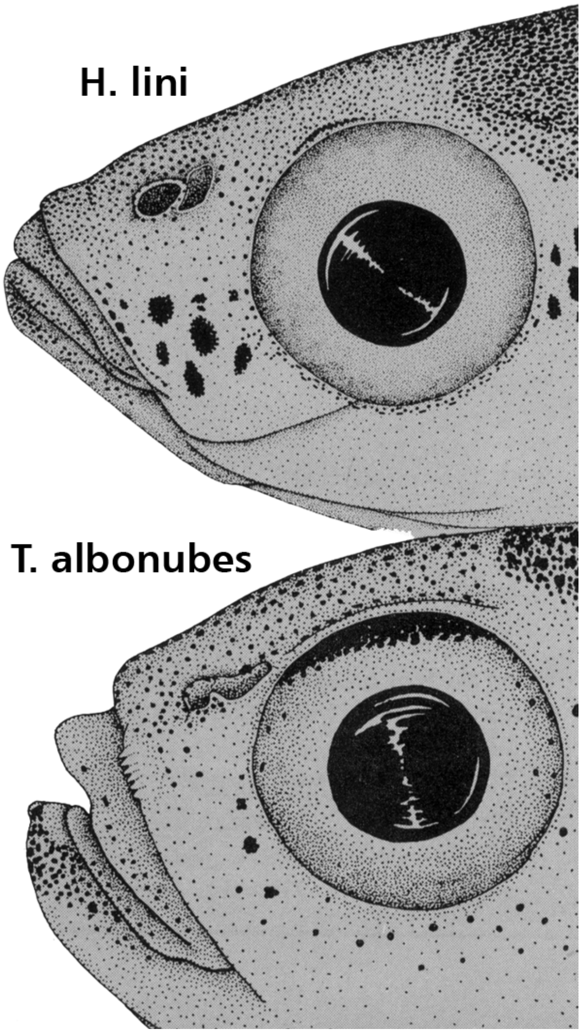
Towards the end of 1938 the prominent American ichthyologist, Dr. Albert Herre, received a manuscript copy from Dr. Lin in which was described a new cyprinid fish from Hong Kong named, *Aphyocypris pooni*. Upon receiving some Chinese fishes which he believed to be Lin's new species, and under the impression that Lin's manuscript had already been published, Herre then wrote an article in February 1939 ("*Tanichthys albonubes* and *Aphyocypris pooni*", AQUARIUM, 7(10), pg. 176) in which he briefly described his new acquisitions. Herein lay the rub, however.

Herre's fish was not Lin's *Aphyocypris pooni*, even though Herre used that name in his article. Lin did not publish his description until April 1939 and, by the Rules of the International Code of Zoological Nomenclature, the name *Aphyocypris pooni* belongs to Herre's fish, not to Lin's. This, of course was a most unfortunate situation since all Herre wished to do was to help aquarists distinguish between the white cloud mountain fish, *Tanichthys albonubes*, and Lin's new species. It was just Herre's luck to obtain a third, somewhat different fish.

As it turns out Herre was really describing two forms (possibly subspecies) of the same fish, *Tanichthys albonubes* ... a Cantonese form and a Hong Kong form. Herre referred to the latter as "*Tanichthys albonubes*" and to the former as "*Aphyocypris pooni*." The differences between 'these two forms are summarized in Table I. Basically, the Hong Kong form has a deep-red dorsal fin tip and lacks white tips on the other fins. Understandably, these two forms, being of the same species, interbreed quite readily. However, through the years the Cantonese color pattern has all but disappeared from our domestic stock of these fishes . . . it is the Hong Kong form that prevails.

TABLE I

ITEM	CANTON FORM	HONG KONG FORM
Horizontal side stripe	Silver or gold	Silvery-blue
Horizontal stripe	Dark-blue in males, brown in females, ending in black spot at rear	Dark-brown in both sexes
Anal fin tip	White	Deep-orange
Ventral fin tip	White	Yellow
Dorsal fin tip	Yellow, then bluish above in males, while in females	Deep-red



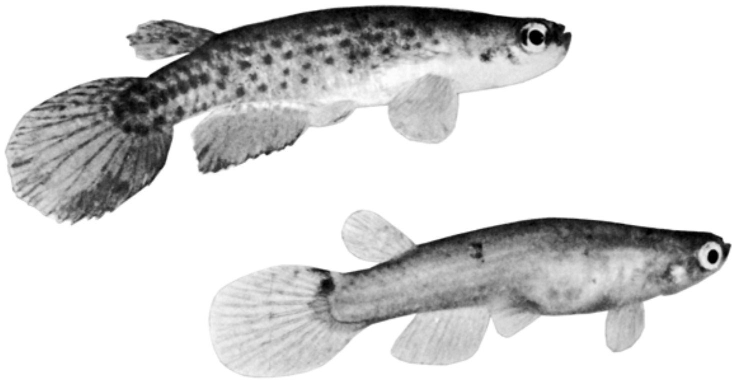
The confusion in the aquarium world due to the existence of the two forms of Tanichthys albonubes is considerable. Karl Stark, writing in a 1942 issue of the German weekly aquarium magazine WOCHENSCHRIFT, discussed the differences between the two forms under the impression that they were two distinct species. Indeed, the English aquarist, R. W. Andrews, repeated the error in an article in the September 1951 issue of AQUATIC LIFE entitled, "White Clouds - Two Species." In 1955, Meinken mixed Lin's and Herre's descriptions of Aphyocypris pooni (in the comprehensive German work, *Die Aquarienfische In Wort Und Bild*) and concluded that "*Aphyocypris pooni*" (in the mixed sense) was specifically distinct from *Tanichthys albonubes* even though they freely interbreed. Sterba (*Freshwater Fishes of the World*) makes a similar error and an even more recent example is that of Schnorrbusch ("Observations on White Clouds", TROPICAL FISH HOBBYIST, 12 (5): pgs. 18-24, 1964).

This, of course, still leaves the matter of Lin's "*Aphyocypris pooni*" which, by the way, was imported into the United States in 1951 as the "garnet" (Rackowitz, M. and S. Weitzman, "The garnet, a new import from Asia", AQUARIUM JOURNAL, 22 (11), Pgs. 216-217, 1951). Although it has been found to be distinct from *Tanichthys albonubes*, "pooni" cannot be used for that name is already occupied as a synonym for *Tanichthys albonubes*. Further, there is little in common between *Tanichthys* and Lin's "*Aphyocypris pooni*." Consequently, the latter has been renamed by Dr. Weitzman and Mr. Chan as *Hemigrammocypris lini*. There are many technical differences between *H. lini* and *T. albonubes*. For example, where the latter has but a single nasal opening on each side of the snout, the former has two (see Figure). The life colors, however, clearly differentiate *H. lini* from either color phase of *Tanichthys*. Briefly, *H. lini* displays a black line from the jaw to the base of the tail fin, ending in a black spot; above the black line is a metallic gold line in young fish, bright green or blue in adults. The back of the fish is brown, the belly silvery, and there is a strong black line on the body at the base of the anal fin. During breeding, the black pigment fades somewhat, and the other colors intensify. Indeed, the metallic line rivals that found in the neon tetra.

A New *Rivulus*

[Aquarium Illustrated, November-December 1966]

During the summer of 1965 I chanced to happen across a new (to me) species of *Rivulus* while browsing through one of Chicago's larger wholesale establishments. The body of the males was bluish-white, the back blackish. Along the sides ran a series of five (more or



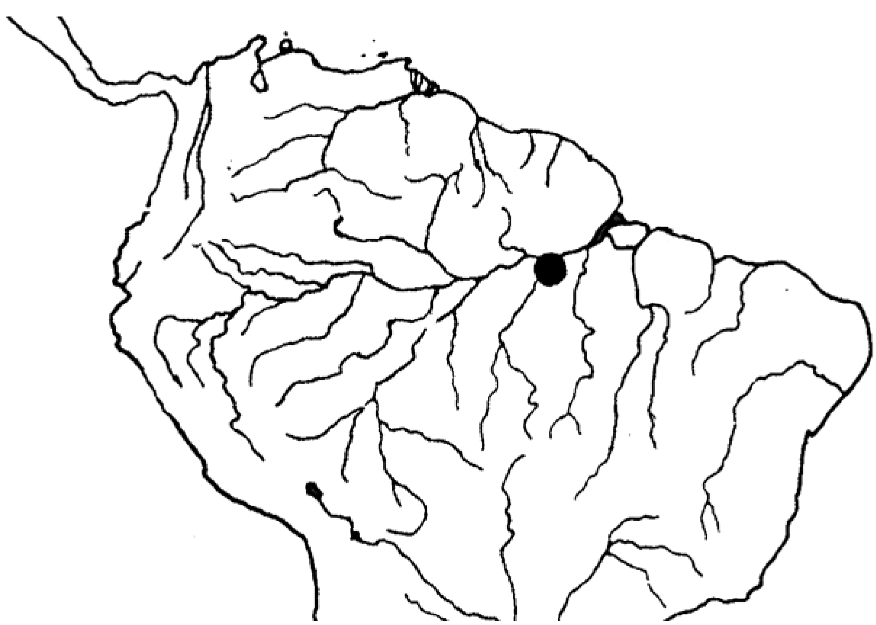
Rivulus ornatus. Photo by Albert J. Klee.

After 6 months without showing additional growth, the newcomer proved itself to be a dwarf species, suggesting that it belonged to the *breviceps* complex of the genus (a hodgepodge of rather smallish forms). An examination of preserved specimens and of the literature available, soon indicated that the fish was *Rivulus ornatus* (See Table I), a species first described in 1895 from Silva, Cudajas, in Brazil. This marks the first published record of the species as an aquarium fish.

less) rows of crimson spots. The ventral, anal, dorsal and tail fins were yellow with numerous crimson spots located along the fin rays (the pectorals were clear). From a distance, then, the male fish took on a mottled, orange appearance. The females were pinkish to light violet, and their ventral, dorsal and anal fins yellowish. Both tail and pectoral fins were clear but the females did have a large, prominent ocellus ("rivulus spot") on the caudal peduncle, actually even extending into the tail fin itself. The fish were very small, not exceeding 30 mm in total length.

The fish bred easily, laying extremely large eggs (1.7 mm in diameter) for so small a species. However, such an egg size (or larger) is the rule with *Rivulus* species, not the exception. The fry were no trouble at all to raise since they took newly hatched brine shrimp from the start. They did well on dry foods and frozen adult brine shrimp when full-grown.

Although a beautiful little fish, I fear that due to its small size, it will not be cultivated by many hobbyists. A similar fate was met by *Cynolebias ladigesi* and *Aphyosemion walkeri*, both smallish but strikingly beautiful killifishes imported some years ago. They are hard to find today.

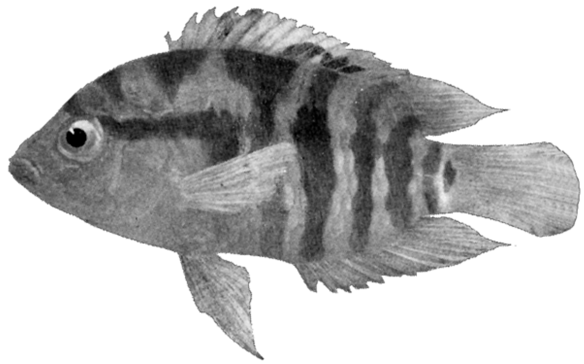


Natural habitat of *Rivulus ornatus*.

The Zebra Cichlid Muddle!

Aquarium Illustrated, January-February 1967. Note: This article was co-authored with Richard F. Stratton, AJK being the Senior Author.

One of the most common cichlids of the aquarium hobby today is the zebra cichlid, also known as the



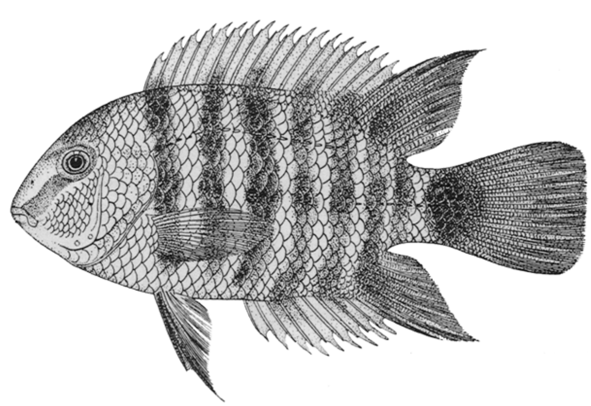
***Cichlasoma facetum* (Henn)**

"convict" or, at times, even the "Congo" cichlid. The last term has been represented by many writers (Innes, Axelrod, and others) as a misnomer on the basis that the fish is of American origin, not African. These writers, however, fail to realize that the term "congo" is a native term, applied to a number of Central American cichlids by these very same natives. For some years now, the scientific name associated by aquarists with this fish is *Cichlasoma nigrofasciatum*. However, several sources (Axelrod Vorderwinkler and others) have challenged this nomenclature, maintaining that the species in question is either *Cichlasoma facetum*, or possibly even *Cichlasoma octofasciatum*. The problem has been further complicated by the existence of a "pink" (= "golden" = "cream" = "white") version of this same fish. The purpose of this article is to show that neither contention is correct and that the correct scientific name is indeed, *Cichlasoma nigrofasciatum*.

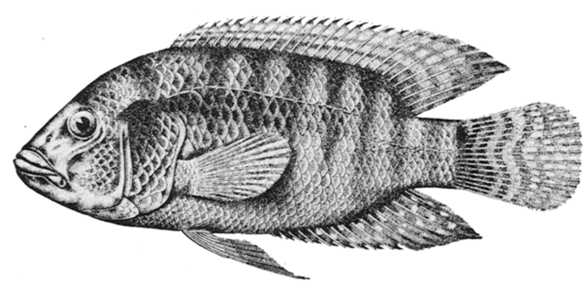
Cichlasoma facetum (Cichla is the name of a related genus; *Cichlasoma*, therefore, means "with a body resembling that of Cichla". The name *facetum* means "elegant") was one of the very first tropical fishes introduced to the hobby. It definitely was our first aquarium cichlid and as such beckoned aquarists to a new phase in fishkeeping.

What sort of a fish is *Cichlasoma facetum*? Firstly, it is large as aquarium fishes go, i.e., 6 to 8 inches usually, up to 11 or 12 inches upon occasion. Devincenzi and Teague, in their Ictiofauna del Rio Uruguay Medio (ANN. DEL MUS. HIST. NAT. DE MONTEVIDEO, 2nd Series, Volume V, No. 4, pg. 87, 1942), state (in translation): **"The extraordinary color variation in this species is well known ..."** Basically, the fish is brassy or yellow-brown to dark-green, but this sometimes turns to ash-grey or black. There are 6 to 7 often-indistinct dark crossbars on the body that extend into the dorsal fin, and there is a dark spot at the base of the tail. Sometimes a more or less distinct lateral band is present. During spawning, the fins are often blackish-purple or even blood red.

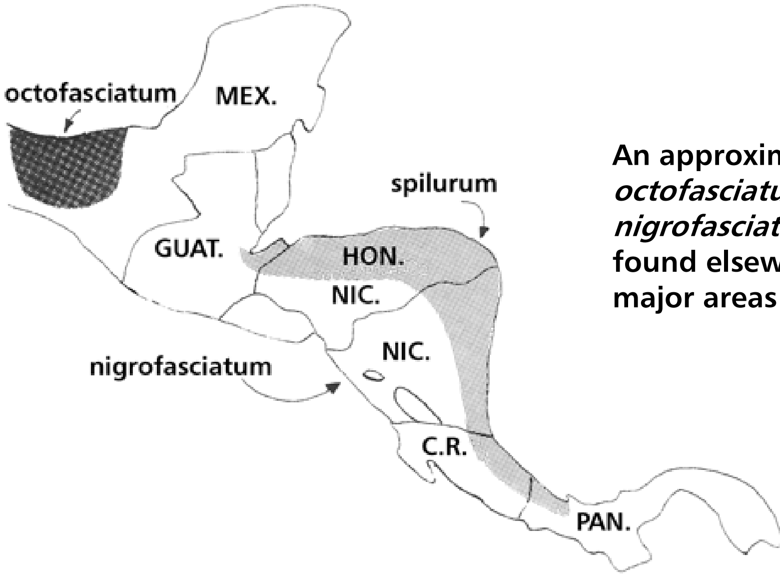
Over the years this fish, which is native to Southern Brazil, Uruguay, and Argentina, became known as the "Chanchito," a Spanish



Fowler's "*Cichlasoma cutteri.*"



The true *Cichlasoma octofasciatum.*



An approximate distribution map of *octofasciatum, spilurum* and *nigrofasciatum*. These species also are found elsewhere on the map but the major areas are shown.

word meaning "little pig," as a consequence of its porcine-like forehead. Although the chanchito was easily bred and very prolific, it was replaced in the hobby by smaller, more colorful cichlids, less prone to fighting and/or digging. The aquarium hobby has seen very few chanchitos during the past few decades. Our illustration shows the short, horizontal bar which occasionally is present in the fish. A color picture of this species is in *Exotic Tropical Fishes* (Axelrod, et al, page F 183.00) under the name of "*Cichlasoma nigrofasciatum*" (the fish pictured on page F. 180.00 as "*Cichlasoma facetum*" is really *C. nigrofasciatum*).

During the early 1930's, a fish known to aquarists popularly as the "Jack Dempsey" and briefly scientifically as "*Cichlasoma nigrofasciatum*," made a great hit with hobbyists. In 1934, however, the real *Cichlasoma nigrofasciatum* (*nigrofasciatum* = "black-banded") was imported, and only then was the scientific name of the Jack Dempsey altered to "*Cichlasoma biocellatum*." This newcomer, the fish generally known today as the zebra or convict cichlid, had a base color of blackish purple-brown and it displayed 7 to 9 black, vertical bars on its body. The first and second bars bent forward across the back of the neck, the second often meeting the third one on the middle of the side to form a V. Although similar in appearance to *Cichlasoma facetum*, it was darker and smaller (about 3½ to 4 inches). Further, *Cichlasoma nigrofasciatum* came from Guatemala to Panama, far from the habitat of the chanchito. Although the zebra cichlid was easily bred, its more colorful relatives

TABLE I

Item	*C. facetum*	*C. nigrofasciatum*	Zebra Cichlid	Pink Zebra
Dorsal	XV-XVIII /9-11	XVII-XVIII/8-9	XVII-XVIII/8-9	XVIII/8-9
Anal	VI-VIII/7-9	VIII-X/6-8	VIII-IX/7-8	VIII-IX/7
SL/SD*	1.75-2.20	2.00-2.25	2.05-2.08	2.10

***SL/SD is the ratio of standard length to standard depth.**

The Zebra cichlid,
Cichlasoma nigrofasciatum.
Photo by Braz Walker.

edged it from any widespread popularity, until the period of the 1950's. At that time, its ease of breeding, its relatively small size and the fact that it really is in many ways an attractive fish, brought it to the attention of a new generation of aquarists and it remained to stay.

In 1963, a Fort Worth, Texas, aquarist named Kenneth Griffin discovered a number of albinos and semi-albinos in a spawn of zebra cichlids. During the attempt to fix the new strain, the pure albinos were lost but the partial albinos (i.e., pink body, dark-colored eyes) were salvaged. Griffin subsequently distributed his pink fish primarily among three aquarists: Mary Barton (Fort Worth), Mrs. Mozelle Watson (Dallas) and Marie McCann (Dallas). Mrs. Watson sent some to Hanna of Miami, Marie McCann sent a number to Guy Jordan (California) and to Carol Honnold (then of Denver, Colorado), and Mary Barton, interestingly enough, sent some to Gulf Fish Farms. This, then, completely documents the origin of this now very popular strain of *Cichlasoma nigrofasciatum*, known today mostly as the "golden convict cichlid".

In recent years a number of our friends have made trips to Central America and have brought back numerous specimens of zebra cichlids. On the basis of geography alone, then, the zebra cichlid could not be *Cichlasoma facetum*. In order to put the nigrofasciatum vs. facetum question to its final rest, however, we examined a number of zebra cichlids, both normal-grey and pink varieties, and made detailed counts and measurements, a small portion of which is shown in Table I.

The two forms are clearly the same species, indistinguishable from *C. nigrofasciatum* and obviously not *C. facetum*. Further, the two forms were interbred successfully by the authors, resulting in an F, generation which resembles the darker-colored parent. It would appear that the dark, or melanic, form is dominant to the recessive pink. The pink form is not, however, an albino since its eyes are pigmented.

Pursuing now another phase of the controversy, as early as 1955 there had been rumblings that the zebra cichlid was not *C. nigrofasciatum* but another species, *Cichlasoma octofasciatum* (*octofasciatum* = "eight-banded"). Further, a number of aquarists are currently convinced that the pink form of the zebra cichlid is *C. octofasciatum*. If one examines the known Central American cichlids that are similar in appearance to the zebra cichlid, three species are immediately eligible: *C. octofasciatum, C. spilurum* and *C. cutteri*. (There are two other pertinent names in the literature, i.e., *C. hedricki* and *C. septemfasciatum*. However, the former is a synonym for *C. octofasciatum*, and the latter is a synonym for *C. spilurum*. The possibility that *septemfasciatum* might be a synonym for *nigrofasciatum* has been rejected by Dr. George S. Myers of Stanford University, who examined these fishes and found them to be quite different. We follow Meek's synonymy then, of *septemfasciatum* with *spilurum*).

In his excellent article in AQUARIUM magazine ("*Cichlasoma nigrofasciatum*", pgs. 6-10, Vol.

34, No. 11, November 1965), Paul Loiselle discusses the differences between *C. nigrofasciatum* and *C. spilurum*, and also the "differences" between *C. cutteri* and *C. spilurum*. However, *C. cutteri* is but a synonym for *C. spilurum* (personal communication, Dr. Robert R. Miller, University of Michigan ... the information currently is in press in a scientific publication). Apparently, aquarists have been under a misapprehension for many years, thinking cutteri to be a valid species. It turns out, then, that *C. spilurum* is quite an old aquarium fish, the recent introductions being merely a re-importation.

This leaves three species, each of which is valid: *nigrofasciatum, spilurum* and *octofasciatum*. On our map we have indicated a number of locations in which these three species are found. It is clear that *octofasciatum* is a northeastern species and although there are several exceptions, basically *nigrofasciatum* is a. fish mainly of the Pacific drainage with spilurum being mostly of the Atlantic drainage. Again, we refer readers to the Loiselle article for a good description of the last two species. (We have, incidentally successfully crossed *nigrofasciatum* with *spilurum*, and with *Cichlasoma meeki*).

Finally, the zebra cichlid is definitely not *Cichlasoma octofasciatum*. From a personal communication from Dr. Myers, we have learned that there is currently a technical paper in preparation that will show that a well-known aquarium cichlid, for years referred to under another scientific name, is the true *octofasciatum*. (Professional ethics, however, preclude us from revealing the name of this fish until publication of the material in question.)

In summary then, we can state the following:
(l) The zebra (= "congo" = "convict") cichlid is *Cichlasoma nigrofasciatum*, not *C. facetum*.
(2) The pink (= "white" = "cream" = "golden") convict cichlid is a semi-albino sport of *Cichlasoma nigrofasciatum*.
(3) *Cichlasoma cutteri* is a synonym for *C. spilurum*.
(4) *Cichlasoma octofasciatum* is not the zebra cichlid, but a well-known aquarium cichlid, long masquerading under another scientific name.

A Betta Experiment

Aquarium Illustrated, July-August 1967]

The dramatically aggressive behavior of the male Siamese fighting fish (*Betta splendens*) towards other males of its species is well known to aquarists. Understandably, the betta has also had its share of attention from scientists and a recent study[1] serves both to show how professionals study fish behavior and how certain aspects of color affect behavior in the fighting fish.
Suppose that we have a male betta situated so that whenever another male betta appears upon the scene, he may perform a particular act. For brevity, we might refer to the performance of the act as a "response." The question now is, does the color of the intruding betta affect the number of responses observed? For example, does a red "intruder" provoke a greater number of responses from a red betta than from a blue betta? I think that readers will find the answers to these questions fascinating.

First of all, let's devise something for our test betta to do. Suppose that, if our test betta wishes to be "visited" by an intruder betta, he must first swim through three gates in an underwater maze in a prescribed order. How this is accomplished is shown in Figure 1. The test betta is located in an aquarium screened on three sides, i.e., he can only see out of one side. Within the tank is a Plexiglas partition containing three holes or "gates." At each gate is located a beam of light focused on a small mirror attached to one side of the gate, such that the light is reflected out onto a photoelectric cell (two such devices are shown in Figure 1). Each mirror is sufficiently small so that the test betta will not be distracted by its own image as it passed through the gates. When passing through a gate, the fish interrupts the light beam, tripping a relay. Further, when (and only when) all three relays are tripped in proper order (specifically 5a, then 5b, then 5c in Figure 1), our "intruder" betta appears upon the scene.

The intruder betta consists of a balsa wood model with colored cellophane fins, the scales and fin rays being drawn on the model with black ink. The model itself is mounted on a toy electric train in such a way that the model, but not the train, can be seen by the test betta. In addition, a very small electric bulb is mounted behind the model so as to illuminate its fins. When the test betta swims through the gates in the proper order, the model slowly travels across the front of the tank, allowing the test betta to follow. After reaching the end of the tank, the train picks up speed and retires out of sight, to be recalled when the test betta completes the next response (i.e., again swimming through the gates in proper order). Setting up such an experiment requires some simple mechanical ingenuity, of course, but it can be done by anyone handy with switches, Plexiglas, toy trains, and the like. Now let's examine the results of some actual experiments.

All in all, three test bettas (male) were used. One was red, another blue, and the third blue with a green dorsal fin (we shall refer to this last one as "blue-green"). Three models were used, i.e., red, blue and green. A total of 10 one-hour sessions were held for every fish-model combination, and the number of responses in each session observed. The results are shown in Figure 2.

The results are exceedingly interesting. The red betta, for example, produced more responses with the green model than with either the blue or red models. It reacted least to the red model! A similar situation existed with the blue betta. It reacted most with the red model, least with the blue. The blue-green betta responded in the same order as did the blue betta

1. 6 Volt Light Bulb
2. Focusing Lens
3. Reflecting Mirror
4. Photoelectric Cell
5. Gate (a, b, and c)
6. Plexiglass Partition
7. Model
8. Fin Illumination Light Bulb
9. Model Electric Train Engine
10. Car Carrying Model
11. Track
12. Aquarium Tank
13. Opaque Screen
14. Live Male Betta (Subject)

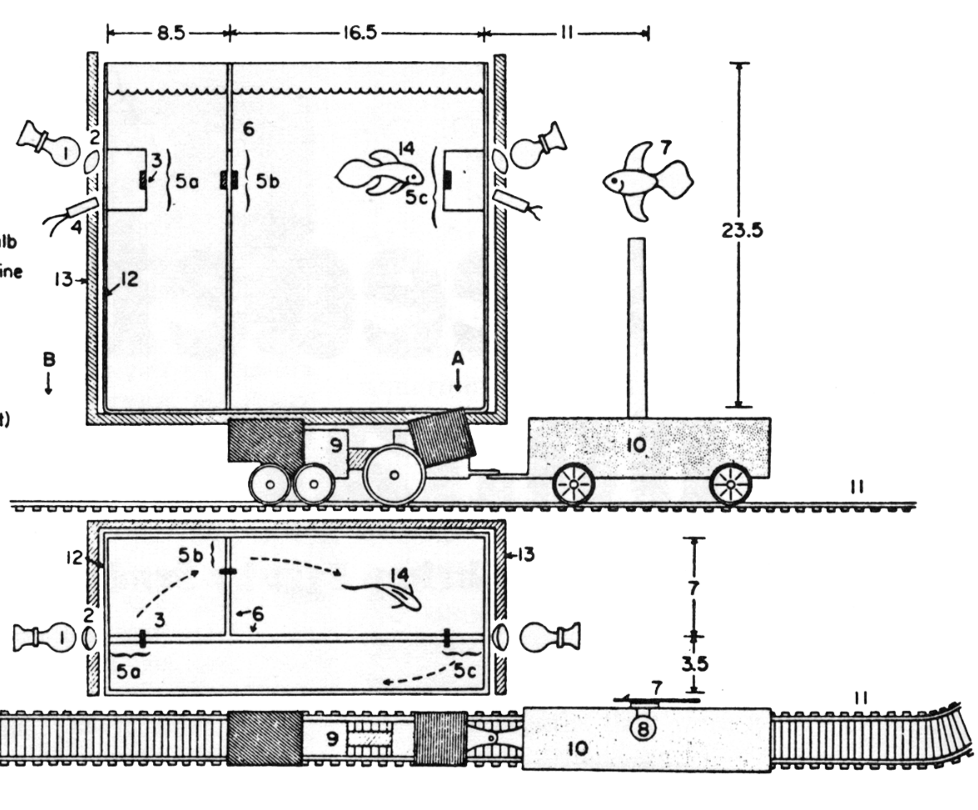
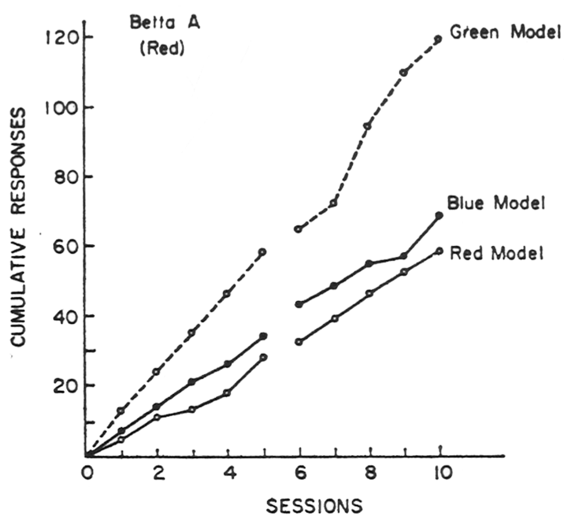


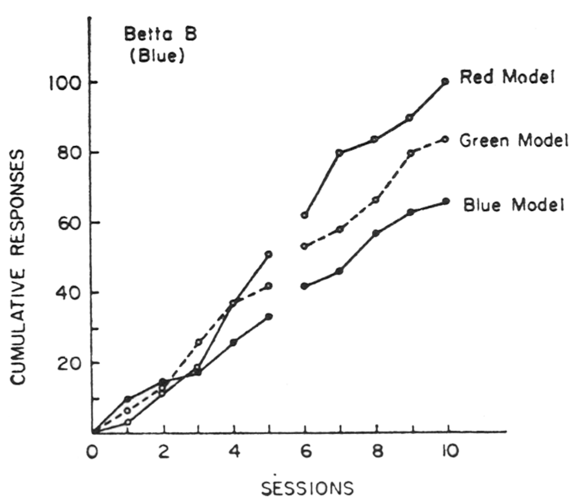
FIGURE 1

except that the difference between the red and blue models was greater than between the green and blue models. For the blue betta, these differences were approximately equal among the three model colors.

In conclusion, it is clear that the aggressive behavior of a male betta toward another male is partly a matter of the color relationship between them. Why this is so is another matter, however, and perhaps some of our younger readers who will someday emerge as scientists themselves, may ultimately provide the answer for us!

[1] From Thompson, "Aggressive behavior in Siamese Fighting Fish", AM. ZOOLOGIST, 6, 629-641, 1966.





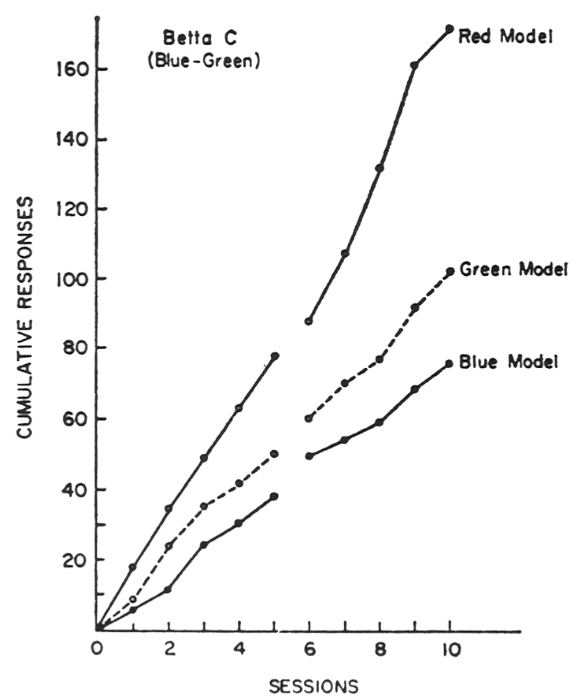


FIGURE 2:
The results of the three sets of experiments. "Cumulative responses" merely means that the results of the last session were added to the previous session. This helps to emphasize the differences among models, rather than just plotting the total number of responses for each session.

An Amazonian Adventure – Part I

[The Aquarium, February 1968]

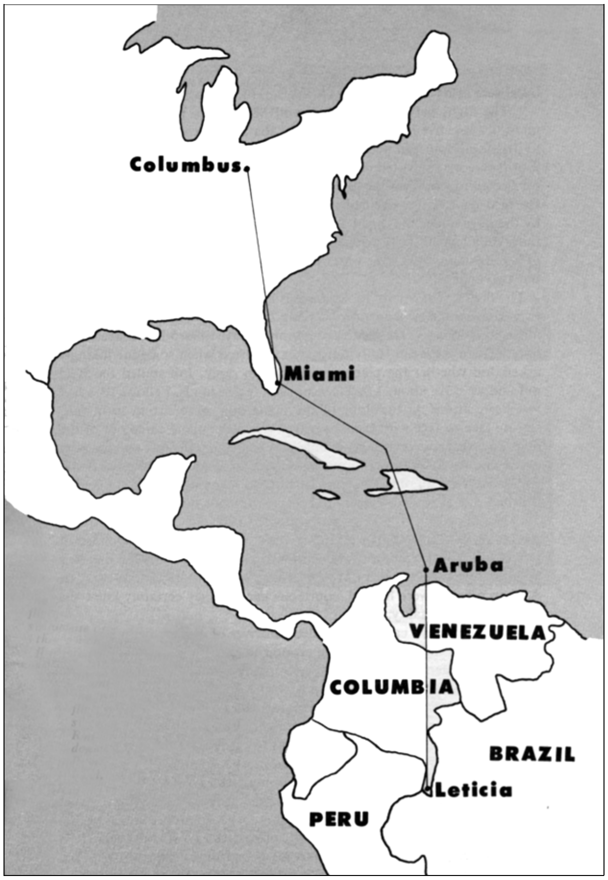
"Another B-25? Not on your life!" This was my reaction to Jon Krause's proposal that we organize another aquarium expedition to the Amazon River Basin. (See "A Peruvian Adventure," AQUARIUM JOURNAL, January through September 1965, Vol. XXXVI, Number 1-9.) "That last B-25 of yours still had flak holes in it from World War II," I added. However, Jon assured me that this one was decidedly different and in painstaking detail, described the changes brought about in the aircraft when it underwent an executive conversion a few years ago (radar equipment, jet-assisted takeoff, wingtip fuel tanks, etc., not to mention a built-in bar!). I weakened fast and when I had viewed the plane myself, my resistance evaporated completely. On this plane, even "small details" such as the hydraulic system worked!

It fell to my friend, Win Rayburn, a Cincinnati aquarist and old "companero," and me to work out the details of the trip. We had had enough of playing Russian Roulette by flying over the Andes in twin-engine aircraft, so we restricted our flight to over just water and jungle. Oh, we might fly over a few teensy-weensy mountains, but we would be darn sure that they were low ones (as I remember, we set the maximum at about 15 feet).

Our initial plans were to fly from Columbus, Ohio, to Miami, then on to Aruba, Netherlands Antilles, where we would spend a day or two. The next leg would be from Aruba to San Fernando in the Apure Province of Venezuela where we would spend a week looking for fishes. The final air flight would be from San Fernando to Leticia, Columbia, located right on the Amazon River. The return flight would be simpler: Leticia to Curacao, Netherlands Antilles, to Miami to Columbus.

While Jon was busy working on flight plans, aircraft maintenance, and securing the necessary permits from the various countries involved, Win and I contacted other aquarists whom we thought might be interested in making the trip. A ready acceptance was received from Dr. Richard L. Stone of New Orleans, La.—another old traveling companion, having accompanied us on a previous trip. Dick is Chief of Psychiatric Services at the Veteran's Hospital in New Orleans, an avid aquarist, and all-round amateur naturalist. We were further fortunate indeed to have "sign up" with us, Vern Parish and Ed Corder, both of Indianapolis and active in that city's aquarium activities. Finally, Clarence ("Norm") Knepper, one of Ohio's best-known aquarists, brought the total up to six.

Oranjestad is a "free port," and goods of all kinds may be purchased at considerable savings. These are examples of Guatemalan tablecloths which, including 8 napkins, cost about $7 or $8.



Route of the Amazonian expedition. The "kink" in the Miami-Aruba leg is due to the necessity of avoiding flight over Cuba. Leticia is situated on the Amazon River (not shown), on a dog leg of Columbia where Peru, Brazil, and Columbia meet.

We were, however, still short of sufficient expedition members to make the trip economically feasible (the aircraft charter and operating costs would come to about $4,500, for example, and this figure did not include the copilot's expenses). Each of us, therefore, was obliged to scout up other candidates. Ed Corder enlisted Warren Dody, a railroad friend from Indianapolis; I secured two personal friends—John Chapman, an engineer, and Duane Wait, a mathematician—both from Cincinnati; Norm signed up two friends of his own from the Dayton area—Earl Elzorth and Marty Harm. Earl and Marty are archers (Earl owns an archery range) and their primary interest was in hunting wild game with bow and arrow. The expedition, therefore, developed an even more exciting nature! With the addition of Jon's son, Jon Jr., and our copilot, Bob Fitzsimmons (Bob even quit his job to come with us), our complement was now complete.

Problems developed, however. For one thing, we could not secure permission from Venezuela to enter and leave at San Fernando. It was Caracas or nothing. Since this would have meant flying 200 miles back to Caracas prior to flying back south to Leticia, we decided to forget about Venezuela except to fly over it. Secondly, "Papa Doc" Duvalier, dictator of Haiti, had warned about flying over his country. Detouring around Haiti would have added another 20 % to our expenses. However, we learned that at the time, Duvalier's air force consisted of only two planes; an old DC-3 and a World War II P-51 fighter. The former crashed a month before our takeoff, and the latter hadn't gotten off the ground in 7 years. So, we said "phooey" to Papa Doc and made our plans accordingly, reminding ourselves to fly especially high over Haiti.

During the weeks of preparation, we assembled our equipment and obtained our shots. Most opted for jungle hammocks but Win decided on a tent. John Chapman produced a machete as wicked-looking as any I've seen, and Duane Wait showed up in a white duck outfit, complete with white sneakers, apparently ready for the yachting season (the fellow who brought along an electric toothbrush will not be mentioned by name!). Norm, Earl, and Marty had so many arrows sticking out from their baggage that it was a hazard to sit carelessly. The real fish man in the crowd was Vern who patiently attended to nets, plastic bags, and other gear.

We took turns throwing each other going away parties and complaining about our shots (Ed maintained that his were delivered via the blunt end of a broom handle!) but the day of

Aruba belongs to the Dutch and their influence can be seen in this windmill, located just out of the capital, Oranjestad. This structure is used as a restaurant.

departure finally arrived. Departure day is usually a mild form of mayhem. The loading of the aircraft must be done carefully to ensure proper weight distribution. Fuel must be pumped on board (the wingtip tanks last so as not to over-tax the wings) and last-minute additions to personal baggage must be made. All this must be done with people climbing in and out of the plane, and with wives, children and family dogs underfoot. At last, our goodbyes were said!

The flight between Columbus and Miami was pleasant enough, a jaunt of some five hours. It afforded us the chance to experiment in how to distribute fourteen people comfortably in a plane built originally for four (someone suggested olive oil). Because we had arrived late in Miami, we elected to stop over the night, not attempting the flight to Aruba until the next day. A few decided to explore Miami's night life, and judging by the bags under the eyes I saw the next day, the plane wasn't the only thing fully loaded the previous evening. This I attributed to the prospects of a 1,200-mile flight over water in nothing but a 22-year old plane with but two engines!

The flight from Miami to Aruba was also a run of five hours. We flew over Haiti without incident, observing only how rugged and barren its mountains looked. The people there must have a hard life, indeed. The only incident between Haiti and Aruba occurred when someone jokingly asked Jon whether the plane could dive. In reply, Jon stalled the B-25 out and we dove about 1,000 feet in just a few seconds. Fellows who had just been sitting on the floor of the plane now were sitting in midair, staring face to face with their baggage. When the plane came out of the dive, down came everything—people plus baggage. The only real casualty was a cup of coffee that now was a part of the ceiling. We never did get the coffee stain out. The cigar I had been readying to light, looked as if it had just exploded. I never did forgive Jon for that cigar.

The approach to Aruba was rough and in jockeying for position, the plane was buffeted about, and so were we. After the first bounce or two (I told Jon I wouldn't t forgive him for that cigar!), the landing was good and we

The island of Aruba is mostly sand with two types of vegetation: cacti and the Diva-diva tree. The latter always point in one direction as the wind blows from the same direction 11 months of the year (and doesn't blow at all during the 12th!).

Fish and produce are brought to Aruba in boats such as this one. Each morning the boats are unloaded and a market miraculously springs up right on the docks themselves!

quickly piled out after we taxied to our parking place. The Aruban officials were helpful, courteous people; they certainly knew the meaning of hospitality.

We rented two cars, I being elected driver of one of them. I backed out of the parking lot and swung around in front of the airport to pick up my passengers. Unfortunately, nothing happened when I stepped on the brakes. After I rolled to a stop against a cactus plant, the Aruban in charge of the agency expressed his apologies (he had just bled the brakes that morning) and turned over his own car to me, saying that he would get the brakes fixed and catch up with us to exchange cars later on.

The fish are tossed right on the docks where they will be cut up on the shopper's orders to suit the family pot that night.

Since Aruba is only 17 miles long, true to his word the original car was back in our hands a few hours later, much to my trepidation.
Aside from the nonchalance with which Arubans view mechanical equipment, Aruba itself was fascinating. The island belongs to the Dutch and is situated about 15 miles off the coast of Venezuela. It is mostly sand, covered with cacti and a tree called the "diva-diva." The branches of the latter point in one direction only, for the wind blows from only one direction 11 months of the year (the 12th month it doesn't blow at all!). Cactus is the main vegetation, however, because the annual rainfall in Aruba is a scant 16 inches.

The capital city of Aruba is Oranjestad ("Orange City"), where we stayed (up to five in a room). The stores were well-stocked with goods, however, and we had a field day buying Guatemalan tablecloths and other souvenirs for our wives who later claimed that these were but acts of conscience for leaving them home with the family dog, the kiddies, and all those fish tanks to take care of. We passed up a boar's head dinner (at $5.50 per head) to dine at the Bali, a floating restaurant featuring a "Rijsttafel" or "Rice table," a complex 20-course Indonesian dinner that took us hours to eat. It was truly superb and I learned to go easy on the "sambal badjak" (a hot-hot red pepper!).

The group split up and I found myself with John, Duane, and Win, driving the length of the island. One end of Aruba consists of a gigantic oil refinery, the largest I have ever seen. We wound up the evening by swimming in the moonlight in the Caribbean, a pleasant end to a pleasant day.

We were up early the next morning, photographing the docks and the market. Produce and fish are brought to Aruba by small boats and each morning, these are unloaded onto the docks that then serve as a sort of outdoor su-

Dr. Richard L. Stone holding a sea urchin which he worked loose with his fingers from the rocks in the background. Another very common sea urchin in this area is colored black and has extremely long spines.

permarket. About noontime, everything is reloaded aboard the boats, and the market disappears. After lunch, we were off on a glass-bottomed boat to skin-dive for the colorful coral fishes that abound in this part of the Caribbean.

An Amazonian Adventure – Part II

[The Aquarium, March 1968]

As we were concluding negotiations for the services of a glass-bottomed boat, I glanced up at a corner of the boat keeper's office and found myself face-to-face with a buzzard. Now parakeets are one thing, but this Aruban pterodactyl eyed me as if I was the last morsel of food on earth. After checking with the proprietor who told me that it kept the mice and burglars away, I recalled Robert Burns' line: "The best laid schemes o' mice an' men gang aft a-gley."

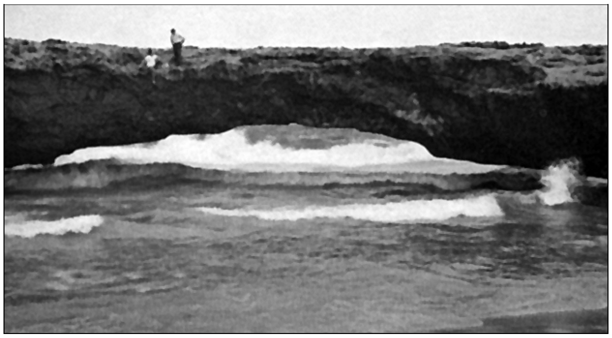
Our glass-bottomed boat turned out to be a scow-like vessel, fitted with four glass-bottomed wells and an outboard motor. As the water was exceptionally clear, the wells were quite functional. We headed out to a coral reef a few miles away, and proceeded to change into our diving gear. Norm Knepper suggested that I wear my T-shirt while diving to protect against the sun. Although I took his advice, Norm didn't and he was to rue that inaction later.

We got into our swimming trunks on board; what the sight of eight or so naked "explorers" meant to the diving birds of Aruba we could not tell, but it certainly did not interfere with their own fishing. These birds would fly 75 feet or so above the surface of the water and, upon detecting a fish, would fold their wings and "dive bomb" into the water. I watched them for a while and concluded that they were successful about 50 % of the time.

As for our own fishing, it was delightful. Coral fishes abounded in the reef and we had but two dangers to be wary of: the sharp coral itself which could slice a diver's skin like a razor, and the sea urchins with their sharp, toxic spines. No one was skewered on the urchins but Win Rayburn was cut up considerably by coral on one dive. The odd thing was that he didn't even know it until he had returned to the boat and we had pointed out to him that he was bleeding at numerous places over his body.

At lunchtime we beached our craft and explored the tidal pools along the shore. One had to step smartly to avoid the cacti that grew

Preparing to depart for an afternoon of skin-diving in our glass-bottomed boat. The water is so clear that the pontoons seem as if they are suspended in air.



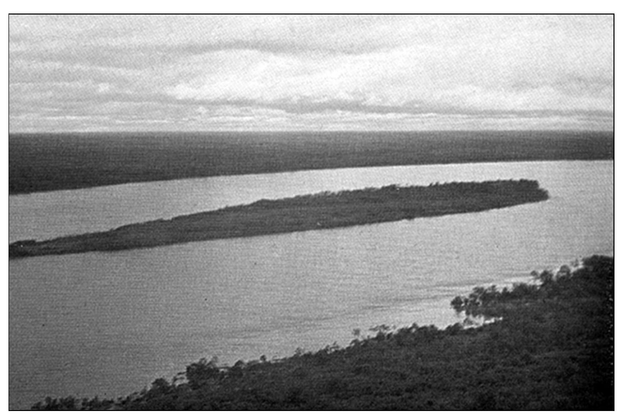
Natural Bridge in Aruba, a natural formation etched into the rock by centuries of wave action. The noise of the surf rolling through under the bridge was deafening.

profusely all over the beach. Doc Stone was busily engaged in picking sea urchins off rocks barehanded, a sort of Russian roulette with loaded invertebrates. We discovered a German tanker that had been sunk during World War II and ran our boat out to it. The hull was covered with algae, barnacles and sea urchins, but colorful marine fishes were everywhere. It was our misfortune that we were headed towards South America on our next leg and could not bring any of these marine fishes back with us to the States.

After four hours or so we started back. At this time we discovered that almost everyone aboard had a bad case of sunburn. I was in fair shape, thanks to Norm's advice, but he resembled a boiled lobster. As he limped his way past the hotel, a native intercepted him and offered assistance. For 50c, the native assured Norm that he had a sure-fire remedy for sunburn. The deal was consummated and stripping Norm to his shorts, the native took his machete and cleaved a large cactus in two. He then proceeded to rub the sticky juices all over Norm's body. This had the effect of turning Norm into a piece of human flypaper, for now everything stuck to him. Further, the odor of the cactus juice was frightful and no one would approach within 6 feet of him. Much to his discomfiture, the juice failed to wash off completely in soap and water, and he remained "fragrant" for several days.

A number of us drove off to the windward side of the island to see "the Bridge," a natural bridge fashioned over the centuries by the action of the waves. This side of the island was no place to swim as it was full of sharks; indeed, the Arubans used it as a sort of garbage disposal site upon occasion. Our evening meal back at the hotel was punctuated by the scampering of lizards across the floor. The food, however, was superb. A few hardy souls ventured forth in one of the cars for another tour of the island after dinner, but most of us retired to our rooms to nurse our sunburned bodies. As I was in the room that contained five of us, the pitiful moans and groans of the afflicted were a hindrance to sleep.

Early the next morning we drove to the airport, filed our flight plan and checked the weather. The weather news was not good. A storm was brewing to the south, over Venezuela, some 15 miles away. As soon as the plane was fueled, however, we spotted a break in the clouds and decided to take off against the control tower's advice. Our decision to take off turned out to be the right one as in another 15 minutes the weather would have made it impossible to clear the mountain range on the Venezuelan coast. We flew through a rainsquall and then prepared for five solid hours of flight over



The Amazon River at Leticia, some 2,000 miles upstream.

Our first sight upon landing at Leticia's primitive airport. This fellow didn't quite make it!

Venezuela and Colombia. We were on our last leg of our trip down at last.

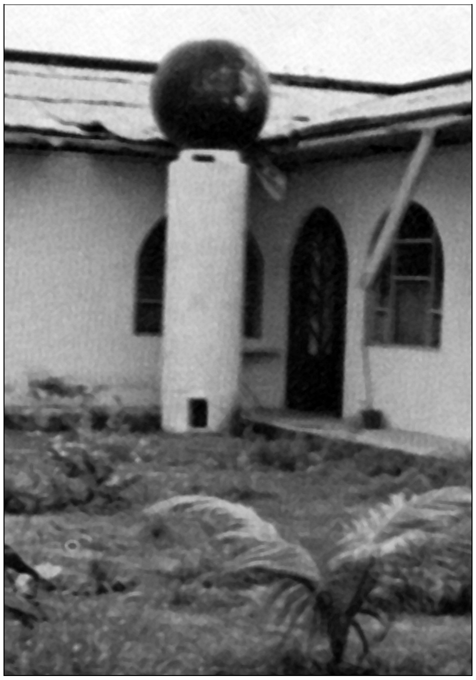
Venezuela appeared to be mostly grassland but as we approached Colombia, the familiar Amazonian rainforest became quite apparent. The sky was misty, making photography difficult; consequently, most of us dozed or read. Our destination was Leticia, on the Amazon River some 2000 miles from its mouth. It was founded as a military port in 1867 by the Peruvian, Benigno Bustamante, but at that time it was called "Puerto de San Antonio." As a consequence of the Treaty of Lozano-Salomon in 1922, the port was ceded to Colombia but this did not become fact until August 27, 1930, when Colombia resolved the question by force of arms. To this day, there is friction between Colombia and Peru over this matter (more about that later).

As for the name "Leticia," there are two versions; legend and history. Legend has it that the great Amazonian explorer, Francisco Orellana, arrived in the region and decided to take some prisoners. One of them, a native girl, was especially pretty and Orellana inquired of her name. She replied that she was called "Leticia," and Orellana decided to name the whole region after her. The historical version is that the town was named after the bride of the Peruvian engineer, Manuel Charcon. Romanticists and pragmatists may take their pick!

We approached the Amazon River and spied the town. The landing strip at Leticia is not the smoothest in the world; as soon as our wheels touched ground we bounced past the wreckage of a Colombian airliner (a C-46). It had slid off the runway two weeks prior to our arrival after its brakes had locked. It was not a heartening sight!

As we taxied to a halt we were met by the "Aduana" or customs people, and started to unload our baggage. Unfortunately, we unloaded the nose and mid-section first; suddenly, someone yelled: "The nose is going off the ground!" Sure enough, the nose wheel was about a foot off the ground and still rising. Several of us dashed into the mid-section and weighted the front of the plane down while the tail was unloaded. Colombian customs cleared us quickly, and we boarded a truck for town, about a mile away.

The main street of Leticia. The Amazon River is in the background.



The courtyard of the hotel Victoria Regia. The tower-like structure was supposed to store water but it was usually bone-dry.

The climate at Leticia varies from a low of 60° F at night, to a high of 95°F in the afternoon. We had arrived just as things were getting hot. Our hotel was the Victoria Regia, a run-down but quaint edifice (Note: by "quaint" I mean that if located in Cincinnati, it would have been condemned by the City) named after the fabulous Amazonian water lily whose pads are four to seven feet across (fully capable of supporting a man). It was run by a gal, formerly married to a Hollywood celebrity, who "wanted to get away from it all." Well, she certainly did!

Our room arrangements completed, we settled right in. John Chapman, Win Rayburn, and I shared a room plus shower (cost, about $2.40/day), the others distributing themselves among various other rooms. Our first shock was on finding the food rather expensive. Beef, for example, had to be flown in from Bogotá; the typical meal cost about $1,00 which, for a jungle town, was outrageously high. We most likely could have supplemented the protein in our diet by the animal life we found in our mattresses, but daily DDT spraying prevented this. A couple of the fellows looked into the kitchen of the hotel with the result that they switched to the C-rations which Ed and Vern had brought, for the duration of our stay.

The second shock was that the water was turned on for only 1 hour a day; theoretically, that is. The town pump very seldom did work and often there was no water at all. Many was the time that we would soap up in the shower, only to find no water with which to rinse. Consequently, we often appeared half-rabid. We all got used to brushing teeth with beer or strawberry soda, however!

The population of Leticia in 1934 was 402 and today it is about 5,000 ("mas o menos" as the Latins are used to saying—"more or less"). It consists of about 50 blocks and 14 or so streets, 2 of the latter even being paved for a 100 yards. However, streets in Leticia are not exactly like streets in the United States. They are marked with water-filled potholes that are favorite cooling-off spots for the pigs that are allowed to run about the town. The few cattle that are in the vicinity are sometimes herded cowboy-style right through the center of town; one must be careful before crossing any streets in Leticia!

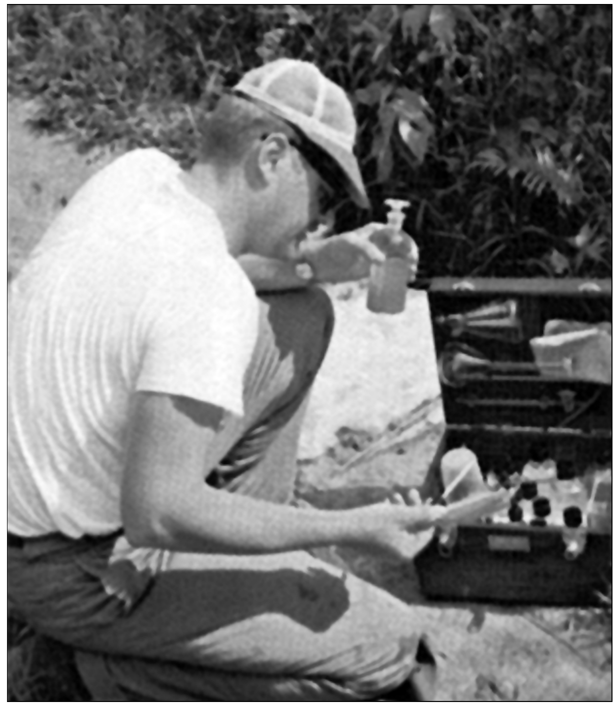
A pet macaw belonging to the owner of the Victoria Regia. Very tame, this beautiful bird would steal the fountain pen from your pocket if you weren't looking!

We found the stores interesting, however, and after getting our hands on some Colombian pesos (worth about 6c each), we cut our cost of living considerably. The local soft drinks could be had for 1 peso, Cokes for 1-1/2 pesos. For about three weeks, most of us existed on canned cheese and sardines, and "cerveza" (beer) when we were not actually in the jungle.

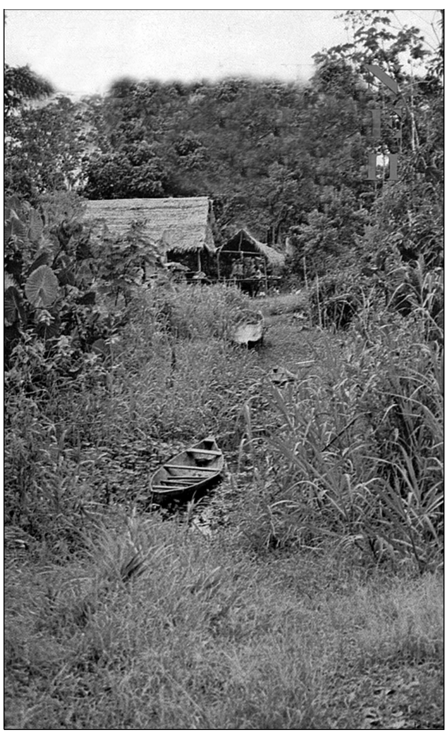
An Amazonian Adventure Part III

[The Aquarium, April 1968]

There are but two ways to enter or leave Leticia; by water or by air. One road out of town merely leads to the "airport," the other to the small village of El Marco which is situated on the Columbian-Brazilian border, but there are numerous dirt paths which are used by the natives for their daily treks between town and the surrounding plantations. One such path led



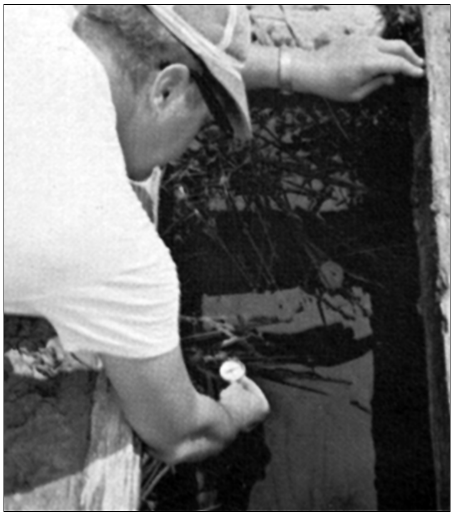
The LaMotte water testing kit in action. At this point, an oxygen determination is in progress. This test takes about 20 minutes to complete.



The entrance to the Ticuna Indian village. The reedy swamp here harbored many thousands of neon tetras!

to a crude footbridge constructed of logs over which dirt had been compacted. We could see several small fishes darting to and fro in the water beneath and elected to catch them.

As the others unpacked their nets, I set up the portable laboratory supplied to me by the La Motte Chemical Co. of Chestertown, Maryland, some years ago. This most excellent water analysis kit enabled me to make eleven chemical and physical tests on water samples, including the more involved ones such as oxygen, iron, and alkalinity. Just prior to our trip, the kit had been completely refurbished with fresh chemicals. The major portion of the analyses from this habitat is shown in Table I. The water was definitely acid, probably due to the dissolved organic material that also colored it a pale brown. As expected, the sample contained little in the way of other dissolved materials such as chloride, hardness, etc. An interesting observation, however, one that I have



Water temperature is taken with a Wesson stainless steel thermometer (glass thermometers are much too fragile for jungle work). Note how dark the water is at this site.

made with regard to other South American water samples, is the significant iron concentration. As the water was sampled at 2:00 P.M., the hottest part of the day, the oxygen concentration was low, a characteristic previously encountered in other South American waters also. The water sample came from directly under the bridge that afforded some shade. Consequently, the water temperature, although high, was not excessive. In aquarist's terms, then, the water in this slow-moving quebrada (creek) could be characterized as warm, acid, soft, low in oxygen and with a discernible iron concentration.

Repeat water analyses were made the following day, the results of which are shown in Table II. As expected, very little changed. This sample, however, was taken early in the morning as compared to the sample of the previous day and consequently, its oxygen content was appreciably higher. The iron content was down a bit, mostly because of the diluting effect of rain runoff water. These rains, by the way, continued to dog our footsteps throughout our trip.

Table I
Water Analysis: Quebrada At Outskirts of Leticia, Columbia

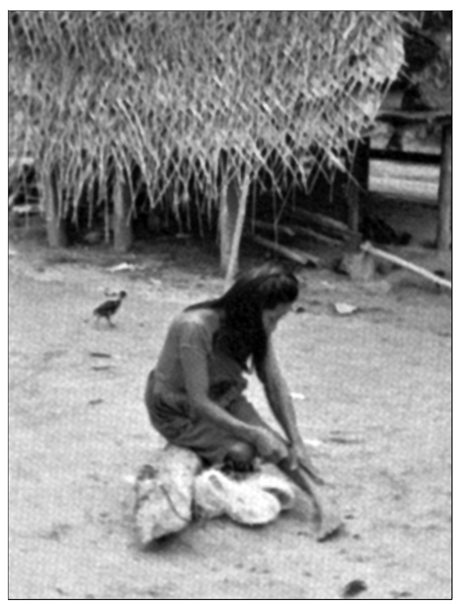
Date: May 30, 1966
Time: 2:00 P.M.

Water Temperature:	78°F
pH	5.9
Hardness (total)	less than 17 ppm
Alkalinity	15 ppm
Chloride	trace
Iron	1 ppm
Oxygen	2 ppm

Table II
Water Analysis: Quebrada At Outskirts of Leticia, Columbia

Date: May 31, 1966
Time: 10:00 A.M.

Water Temperature:	79°F
pH	6.0
Hardness (total)	less than 17 ppm
Alkalinity	15 ppm
Chloride	0.5 ppm
Iron	0.5 ppm
Oxygen	5.0 ppm



This Ticuna woman is making rope, twisting the strands of hemp by rolling them along her leg.

Unfortunately, the bridge was hemmed in by the jungle, making it impossible to fish with a seine. The only feasible access was through a hole in the bridge itself, but this was too small to permit effective use of our nets. Consequently, we were forced to resort to the minnow traps that we had brought with us from the States. We located one trap, baiting it with bread, and the next day (the day of the second water sample), returned to find a rather scant catch of but a dozen or so fishes. Included, however, was a tiny *Apistogramma*-like species that was new to me. The remainder included one *Callichthys*-type catfish, one *Aequidens* species, and several rosaceus tetras and nondescript, silvery-colored tetras. We bagged our catch and started back to town.

The next day permitted early risers to sample the delights of the market at Leticia that was located right on the Amazon River. Here, river craft tied up and loaded and unloaded their cargoes. Various kinds of Indians were well represented and occasionally, their wares were strange indeed! I almost stepped on a South American porcupine that was tethered to a piece of wood lying on the banks. The smells of the market were as interesting as the sights. One native set up a bread stand on the waterfront. The bread, being fresh-baked, was an olfactory delight. Perhaps the most interesting building on the waterfront was the hide warehouse, however. Inside were thousands of caiman ("crocodile") and peccary (wild pig) hides, each rolled up in a mixture of salt and Paris green. The aroma here left much to be desired!

A Ticuna "monkey mask."

The houses of the Ticunas are up on stilts to keep them dry when the Amazon overflows its banks.

We ran into some trouble as we photographed the two gunboats moored by the market. The Columbian Government keeps these vessels at Leticia (they are old World War II destroyer escorts, obtained from the United States) as a precaution to possible hostile action from the Peruvians (the Peruvian town of Ramon Castilla is just opposite Leticia, across the river). This is a sensitive situation, reflected in the fact that the Governor of Amazonas Province, in which Leticia is located, is a Columbian Naval Officer. Thus, administration is vested in the military. The Columbian sailors had fits when they saw our cameras pointed their way and when they shouted and commenced to secure their side arms, we scattered! Later, I had to explain to several members of our group just what the sign, "Se prohibe sacar fotografias," meant!

One got used to seeing all sorts of strange objects tucked under arms on the waterfront. This is the winner of the 1968 Charles De Gaulle look-a-like contest!

Almost immediately after landing in Leticia we had made contact with Mike Tsalickis, an American of considerable influence in the town and a candidate for a READER'S DIGEST "most unforgettable character" profile. Indeed, in the May 1966 issue of that magazine, an article appeared which described his activities in Leticia ("Revolution On The Amazon"). Mike is part owner of the Miami-based Tarpon Zoo but spends most of his time in Leticia where he oversees an extensive animal compound (more about that later). In any event, Mike arranged canoe transportation for us to Mari-Acu, a Ticuna Indian village in Brazil some 30 minutes downstream from Leticia (but one hour to fight the current upstream back to Leticia!).

When traveling downstream it is customary to keep to the center of the Amazon; when traveling upstream, to keep to the banks. This is to take advantage of the currents which are swift at the center, and much less so near the shore. The Amazon is not ordinarily a rough stream, but it is both swift and muddy. After a half-hour had elapsed, our guide turned into the mouth of a reedy tributary that emptied into the Amazon. Mike remarked that neon tetras could be caught by the thousands among the vegetation. This took me by surprise since I had always thought that neon tetras were inhabitants of peat-stained, acid waters of jungle pools.

We tied our boats to the shore and proceeded afoot into the jungle. The Ticunas are basically a river tribe and as such, their huts are on stilts rather than directly on the ground. Most of the men were in the jungle, cultivating their banana and other crops—only a few oldsters were in the village. One of them, however, was in the process of drying wood for arrows, the great lengths of which made me observe that the Ticunas didn't need to get close to their game - with those long arrows, they were already close to it!

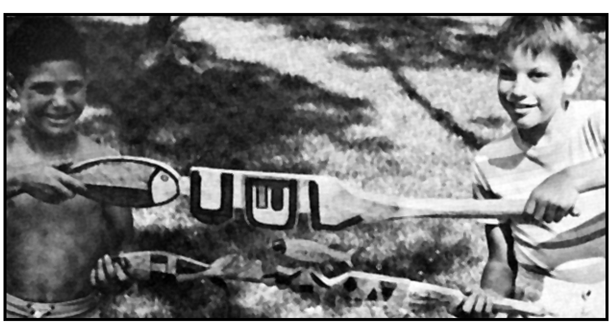
All of us bartered with the Ticunas for various items - small necklaces, arrows, woodcarvings, and the like. We used only one peso notes (= 60) as the Indians could not tell the difference between them and notes of higher denomination (they were often victimized by traders because of this failing). In the live bird depart-

The market at Leticia. Our visit took place in the so-called "dry season" but it rained almost every day.

Win Rayburn, holding a blue tanager.

ment, we even managed to trade for two blue tanagers and a South American version of a kingfisher. In the meanwhile, we learned of the peculiar "hair-pulling" rite practiced by the Ticunas to celebrate the female marriageable condition. When a Ticuna girl attains the age of puberty, the villagers prepare great quantities of an alcoholic beverage called "chicha," made from the roots of a local palm tree. The women of the tribe paint several of the hairs on her head with a bright-red paint, and then tie it into a bundle.

Then follows several days of dancing and drinking. At various times, male tribal members dressed in masks and costumes of bark cloth representing monkeys, dash out of the jungle carrying "monkey sticks." These participants dance wildly and use their sticks to pound upon the ground. Many of the sticks, which are made of thick balsa-like wood, are carved in fish motifs and several of us managed to secure a few.



The author's son (in shirt) and a friend holding two of the "monkey sticks" carved in a fish motif.

The length of these festivities varies. The merrymaking is strenuous and the Indians may elect to halt and "sleep it off," only rising to resume the ritual. Sooner or later, however, the dancing and drinking stop (usually the chicha gives out!), at which time the women of the village take the girl and pull out most of her hair, several strands at a time, leaving only the bundle in the center previously painted red. The process, although uncomfortable, is not unbearable and it is borne in silence. (We saw several girls who had recently undergone the ceremony, and their heads appeared covered with a fuzzy down!). Finally, the Chief of the village takes the girl down to the river and, in a sort of baptismal rite, dunks her head under three times, after which he pulls out the remaining bundle of hair. At this point, the youngster is considered eligible for marriage. Knowing the torture that American women go through in our beauty parlors, I can't see very much difference!

An Amazonian Adventure Part IV

[The Aquarium, May 1968]

Our most fascinating pastime while in Leticia was visiting Mike Tsalickis' animal compound where we enjoyed unfettered access to the cages and pens. After viewing animals in zoos at a respectable distance for many years, it was an exciting experience, for example, to be able to step into a tapir's pen and "pat" it on the nose. The tapir, *Tapirus americanus* (its native name is "Sachabaca"), is a rather shy, solitary creature, nocturnal and inoffensive. A vegetarian, it measures up to 3 feet 6 inches at the shoulder, and tips the scales at about 400 pounds. Its main food is the aguaje, a fruit also popular with the natives (indeed, it is made into a soft drink after first soaking to remove the scaly outer cover - the Kool Aid of the jungle!). I had to chase this "Sachabaca" all around its pen until it tired and finally lay down long enough for me to photograph it.

Right. The business end of an anaconda. A/though it kills by constriction, its mouth is filled with very many short fangs.

The Amazon jungle is profusely inhabited by sundry birds of beautiful and brilliant colors. These birds, however, are generally mute or of not too pleasant warble. Consequently, the jungle is a lot quieter than many are led to believe. There were many kinds of birds at Mike's compound, particularly parrots and their relatives such as macaws and cockatoos. Parrots are usually gregarious and monogamous. Their flight is low and wave-like, but powerful nonetheless. Primarily vegetarians, an unusual characteristic is that they hold their food in their claws. Toucans and toucanettes, birds with huge but light beaks, also abound in the compound.

The most numerous animals in the jungle, however, are the monkeys. They masquerade under such native names as maquisapa, choro, coto, arahuato (howler monkey), huapo, frailecito, pichico, and leoncito. Two were of especial interest to us at Mike's; the wooly monkey (*Lagothrix lagotricha*), and the wooly saki (*Pitcecia monacha*). The former has a human sort of a face and a powerful prehensile tail used for picking up objects as well as for climbing. Earl fell in love with one of them and made arrangements to have it shipped to his home. The wooly saki is an odd-looking fellow with a bushy tail and whiskers of long, loose fur. In one cage, Mike had over a hundred squirrel monkeys and from it, I learned where the expression, " … the joint is really jumpin' ," came from!

The compound also featured many kinds of snakes, the deadliest undoubtedly being the bushmaster (*Lachesis mutis*) or, as the natives call it, "Shushupe." These are the largest of the vipers, some natives claiming that they have seen them up to 16 feet long and as thick as the calf of a man's leg. Mike's snake, however, was about 7 feet long. Its venom is deadly and it has a reputation for attacking without provocation where it then pursues its victim in a wild chase. Mike had a very close call with his snake. In the process of showing us its fangs, the snake's head temporarily got away from him and a fang grazed his thumb. The result was that Mike was pretty sick the rest of the day, but gave thanks that the fang had not actually penetrated his skin.

Perhaps the most spectacular snake in the compound was an anaconda (*Eunectes murinus*). The anaconda rivals the reticulated python as the largest snake in the world, reaching

A small portion of a 20-foot anaconda with the author, in the middle, trying to pretend that he is doing anything at all In attempting to hold that snake!

A tapir at the Tsalickis Compound. These animals reach a weight of 400 pounds.

a total length of 30 to 45 feet, and a weight of 360 pounds. It feeds chiefly at night upon birds and other animals that it kills by constriction. Even good-sized caymans (the South American version of the crocodile) are regularly killed and eaten (most of the snake's time is spent in the water). The young are born alive, about 36 inches long at birth, and a brood of 72 has been recorded. A group of us attempted to "straighten" Mike's snake out, but it wasn't that easy. The movement of the anaconda under my arm indicated nothing but sheer power.

When all is said and done, however, big animals are not generally a hazard in the Amazonian jungle as they only attack man in self-defense. Poisonous snakes are the animals that offer the most danger because they abound precisely in the places where man travels most. But even though the Amazonian jungle is the biggest, thickest, and most mysterious in the world, it can be said that its beasts are not as abundant or fierce as those who never entered them imagine, and only know what they read in fanciful books, magazine articles, and movies. There are no elephants, gorillas, rhinoceros, tigers, lions, bears, or hyenas. The anaconda is inoffensive, either because it is seen easily or because it moves slowly and is almost always sleeping. Even the jaguar itself, in spite of its classic fierceness and treachery, runs away from man and only attacks when it has eaten human flesh, is very hungry, or defends its brood.

The true wild beasts, the ones that harass man the most and from which man defends himself with the most difficulty are the mosquitoes, the isangui (an insect which lives in the grass and when stepped on, climbs to the body and lives for several days causing strong burning), the manta blanca (an almost microscopic fly with a sting that causes a swift and strong itch), the insula (an ant of terribly painful sting), the tangarama (another stinging ant), and the huayranga (a very venomous wasp). There is even an insect, the virote zancudo, which injects worm larvae into the skin; in a few days after the bite a bulge appears in the skin, which has to be cut, the larva taken out and tobacco applied.

It was decided now that the time for real exploration had arrived. The plan was to split into two groups: John, Norm, Jon Jr., Earl and Marty were to head downstream into Brazil and hunt with bows and arrows; the rest of us would travel upstream (175 miles!) into northern Peru to search for the Yagua Indians. While our canoes were being supplied, I directed my efforts to a water analysis of a sample of the Amazon taken at the Leticia dock area. The results are shown in Table I. The major differences between this sample and those from the quebradas (creeks) at the edge of the town were that the Amazon water was more alkaline, of higher pH, iron, hardness,

The bushmaster is one of the most dangerous snakes in the world.

One of the oddest of the lot - a wooly saki monkey.

and chloride content. In addition, the river water was of lower oxygen content, probably because of the great quantities of mud carried in the water. With such differences, one might expect the fish fauna to be different also. This was exactly the case. Large fishes were the rule in the river. Indeed, Mike Tsalickis regaled us with tales of the giant Amazon River catfish that is known to swallow unfortunate natives who happen to fall overboard. On a number of occasions, these catfish have been captured and disemboweled, to give up the remains of a dog or even a child.

TABLE I
Water Analysis: Dock Area
At Leticia, Columbia

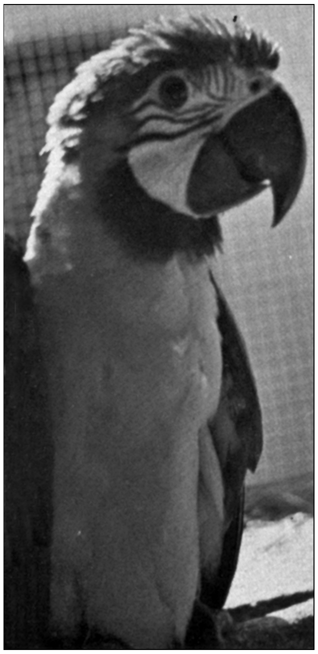
Date:	May 31, 1966
Time:	11:00 AM
Water Temperature:	79°F
pH	7.1
Hardness (total)	68 ppm
Alkalinity	45 ppm
Chloride	3 ppm
Iron	3 ppm
Oxygen	3.6 ppm

Our boats provisioned, each group took off to their respective destinations. Mike had warned us that a previous party had attempted the trip only to turn back because of the difficulties encountered along the way. We were not easily discouraged, however.
All along the Amazon River, different types of craft could be seen, including native canoes. Plantations lined both shores and we refreshed ourselves with limes from the trees on one of them. The false idea is sometimes given that the Amazon River is a desolate waterway; nothing could be further from the truth. In reality, it is the “Interstate Highway” of the region, busy with traffic and lined with habitations. Travel on the river is generally restricted to daytime for its currents are strong and there are many hidden obstacles.

We were traveling in two canoes; Duane Wait and I were in the provisions canoe with Arnoldo, a Portuguese, as our guide. Guide for the other canoe was Pedro, a Peruvian. These were cheerful, courageous men, and we came to love them as brothers. Our canoes were driven by specially designed Amazon River outboard motors, made in Sweden. These had two speeds - “on” and “off”! Every few hours, the canoes had to be stopped, the motors refueled and sparkplugs cleaned. Another job of the guides was to bail as the canoes leaked continually.

Our first stopover was at the home of Pedro’s brother. Although primarily a farmer, he had

A typical Amazon River settlement.



One of the very many brilliantly colored parrots at the compound.

worked for Paramount Aquarium and their compound was still standing. It was necessary to cross over from Columbia to Peru to reach the camp and unfortunately, the light was fading fast. Indeed, we approached the border in complete darkness, with only our flashlights to guide us. There was a strange flickering of lights coming from the shore, but we ignored them and pressed onward across the border. We were to rue that action later, as we found out.

We reached the home of Pedro’s brother and the guides started supper. Jon Krause stuck his hammock on two hooks in the house, jumped in and promptly fell to the floor, hammock and all, as the hooks gave way. Laughing, the rest of us pitched camp outside, shortly to say some nasty things about the manufacturers of jungle hammocks who didn’t make a product designed to be put up in the dark. After a rather cold meal, we tackled the problem of getting into our hammocks, with all the grace of hippopotami doing the bunny hop. It was a sight to behold.

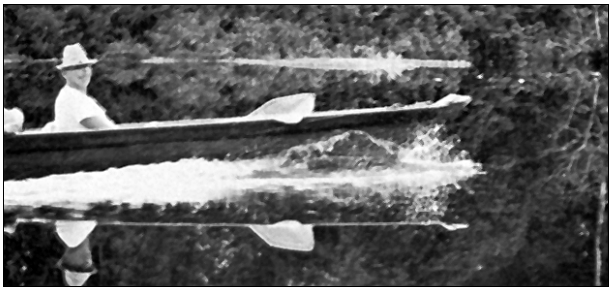
An Amazonian Adventure Part V

[The Aquarium, June 1968]

The next morning, while our guides were preparing breakfast, we secured our gear and prepared for another day on the River. There was an air of excitement in camp because we all knew that it would not be long before our canoes would leave the Amazon River proper, and turn up the Rio Atacuari, ultimately to enter the Yacarite River in northern Peru. These waterways would be less heavily traveled and indeed, approach what could only be termed desolation.

Our canoes loaded once again, we climbed aboard and prepared to negotiate the half-mile or so to the River. To do so, however, it was necessary to travel past a Columbian Guardia Nacional military post. Although we had not anticipated stopping there, an invitation from the post Commandante and an armed squad of soldiers persuaded us to do so. To say that the Commandante was hot under the collar is an under-statement. It turned out that the lights from the shore that we had ignored the night

Babalonia's home, deep in the heart of the jungles of northern Peru.



So many fish were jumping into our canoes that John Krause positioned him-self in front with a net, ready for instant action!

before were signals from the post to stop for identification. We were under suspicion of being (a) smugglers or (b) a raiding party from Peru. Jon Krause and I, as interpreters for the group (neither the soldiers nor our guides spoke English), accompanied the Commandante to his headquarters, a cabin up the hill a few hundred feet. Left behind were our friends and two soldiers, the latter leaning on their rifles and smoking nonchalantly. We were all worried, to say the least.

When the Commandante heard our story and learned that we were "norteamericanos," we were off the hook. Our guides, however, were subjected to a long, violent tongue-lashing. While this was going on, Jon and I decided to play a little joke. We returned to the others with a cock-and-bull story a mile long to the effect that we were all under arrest, that the Commandante was going to toss us in the stockade, and that it would be years before we ever saw home again. This really shook up the group and Ed Corder took a solemn oath that, if he got out of this one, he would never set foot out of Beech Grove, Indiana, again. Jon and I returned to the camp headquarters to see how our guides were faring and, upon our return, announced that if we paid a 1,000 peso fine, we would be released. This was a mean trick since we didn't have 200 pesos among us! Another hour passed and our guides were released. We told our friends that, due to the magnificent persuasive powers of Jon and myself, we were free to go. To this day, not everyone who was on this exploration knows what the reader knows now!

I had an opportunity to make a series of short tests on a sample of Amazon River water, taken after we resumed travel, roughly at the point where the Rio Atacuari entered the Amazon River (see Table I). Compared with the water sample obtained at the Leticia docks, the results were essentially the same. The water was moderately soft, about neutral, and contained an appreciable quantity of iron.

TABLE I
Water Analysis: Amazon River, near the mouth of the Rio Atacuari, North Bank - May, 1966

pH	6.9
Hardness	68 ppm
Alkalinity	40 ppm
Chloride..	4.5 ppm
Iron	2 ppm

Later in the morning, after being on the River

Someone once asked if the crocodiles in South America grow very large. Here the author's family prepares for the long, tedious job of curing a black caiman skin, collected while in the Amazon. Without head and part of the tail tip, it measured 13 feet, 4 inches! Shown is just the belly skin.

Traveling on the Rio Atacuari. From stern to bow - Our guide, Pedro; Babalonia. Warren Dody, Ed Corder, Win Rayburn, Richard "Doc" Stone, and Vern Parish.

for several hours, we turned up the Rio Atacuari. Not only did we see fewer canoes and habitations, but also things were much quieter. We passed the Peruvian military garrison but were not required to stop. Soon, the character of the water changed markedly and for the first time, we found ourselves on a true Blackwater river. The river water appeared as black as ink and served as a giant mirror, reflecting canoes and their occupants with perfect fidelity.

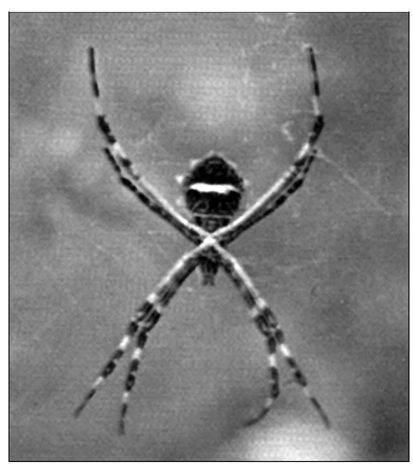
Blackwater Rivers have their origin in the Clearwater ("Whitewater") rivers that flow from the granite mountains of South America. When the Clearwater Rivers reach the flat Amazon Basin, their beds widen.

During the rainy season (in the middle Amazon Basin region this is from the end of December to the end of May - we were just at the tail end of the rainy season) large areas of rainforest are inundated when the rivers overflow their banks. Great quantities of organic material, mostly humus, are leached from the forest floors and enter the rivers. By virtue of this organic material, the water is colored dark-brown to blackish. Further, it is low in calcium and contains many free acids (tannic acid and others). The fish fauna is only moderate as the water is poor in food animals. Stream velocity is reduced as a consequence of the widening of the beds. My water analysis (Table II) confirmed these general observations—Blackwater is very acid and contains very little in the way of dissolved materials. However, the inevitable high iron content was certainly present.

TABLE II
Water Analysis: Rio Atacuari, twenty miles from the Amazon River - May 1966

pH	5.5
Hardness	less than 10 ppm
Alkalinity	15 ppm
Chloride	2.5 ppm
Iron	2 ppm

As we entered the Yacarite River, a tributary of the Rio Yaguas, our sense of isolation increased and the changes that were occurring were subtle indeed. For one thing, the stream (the Yacarite is a narrow river) banks disappeared under the vegetation that engulfed them. At one point, when it was decided that we would stop and eat, our canoes drifted into the tangle of overhanging branches and vines. Our companion canoe was almost immediately swarming with reddish Tangarama ants, most of them proceeding to attack our co-pilot, Bob Fitzsimmons. Watching him yell, jump, and squirm, we all thought it pretty funny until a



One of my "companions" at the jungle camp site!

Our camp site in the heart of Yagua Indian territory. The Indians make "permanent" overnight camp sites on their frequently traveled routes.

number of the varmints got into our jockey shorts as well. No discotheque ever saw such dancing! Our guides got our canoes back into the middle of the river, and peace reigned once again.

It was necessary now to pick up a Yagua interpreter for neither of our guides spoke that exotic tongue. We wended our way through one sacarita after another. This is the name given to the channels or fiords that join one river with another. In essence, they are aquatic shortcuts that can be cruised in vessels of limited draft such as canoes. There are so many sacaritas, and normally of a very complicated course through the jungle, that they are usually known only to the nearby residents. Any stranger who dares to travel through a sacarita must be quite sure of its course for otherwise there is the possibility of getting lost in unending marshes. In time, we reached the home of Babalonia, our interpreter to the Yaguas.

Babalonia, who was a boy of about 14, lived with his family at the edge of one of the tributaries of the Yacarite. While our guides proceeded to complete the hiring arrangements, we made friends with some of Babalonia's younger brothers and sisters (the adults were too shy to confront us) by offering them various kinds of candy. We had long since learned to carry candy for just such occasions. Needless to say, the candy made a big hit!

We returned to our canoes, Babalonia perching in a squatting position at the very tip of Pedro's canoe. How he managed to squat for hours upon end, without moving a muscle, was beyond us. He was a serious-faced boy, and never cracked a smile but once. The occasion involved a case of acute diarrhea (a malady which got us all at one time or another) in one of us (who shall remain unidentified - we are sworn to secrecy!). As explained previously, it was seldom possible to approach the shore because of the impenetrable brush that lined the banks. Diarrhea doesn't wait and he had a real emergency on his hands. Quickly lowering his trousers et al., and hoisting his derriere over the gunwales just in the nick of time, he increased the nitrogenous content of the Yacarite many fold. Our guides nearly fell out of the canoes, laughing, and for the first and only time, Babalonia's face broke out in a broad grin.

It was getting dark and it became necessary to search for a campsite. Because of the jungle growth, this was not easy but we finally found a tiny clearing, used by Indians traveling in the region. We had to scramble up a steep bank to get to the top. As our guides prepared dinner, we set to work with our machetes to clear individual tent and hammock sites. Duane Wait and I elected at first to use one of the canoes in which to sleep, but the canoe leaked and when a bottle punctured our air mattress, we gave up and hung our jungle hammocks with the rest.

We sat about the campfire and recounted the experiences of the day. I strung my hammock with a minimum of difficulty, shed my boots, and went to sleep. Like the others, I was drenched with perspiration but slept in these wet clothes nevertheless. As there were growls and other strange noises all around us, Bob slept with his .38 in its holster, right by his head. The single shotgun we had with us was

Two Amazon porpoises of the genus Sofa/la, breaking surface. On occasion, these creatures came within ten feet of our canoes!

useless, as the shells had swelled with moisture, making it impossible to insert them in the breech.

At about 3 a.m., we were all awakened by shouts and a stream of cuss-words emanating from Ed Corder who, while turning in his sleep, managed to get himself hopelessly twisted up in his jungle hammock. It took Warren a half-hour to free him! Meanwhile, the temperature had dropped to the low seventies and now I was really cold. My clammy clothes added to my misery as did the manta blanca flies that came right through the mosquito netting to bite at will. Sounds of the Otorongo (Amazonian jungle tiger) could be heard on the other side of the river.

An Amazonian Adventure Part VI

[The Aquarium, July 1968]

Preparations for resumption of travel the next morning were carried out by all in a highly cheerful manner as it would not be long before, after negotiating a few more sacaritas, we would temporarily abandon our canoes and tackle the jungle on foot. In an hour, we had packed, eaten, and broken camp.

After a short time on the river, Babalonia pointed out a landing spot for our canoes. Leaving Arnoldo to guard our belongings, the rest of us followed Pedro and Babalonia into the jungle. One of the things that slowed us down the most, however, was in crossing the quebradas, or creeks, that crossed our trail. These quebradas were generally in deep ravines and consequently, it was not possible to ford any. We were obliged to use the fallen logs that characteristically spanned them. Although the natives seem not to have any trouble in crossing the logs barefooted (indeed, Pedro and Babalonia scooted across them as if they had spiked golf shoes on!), it was not so easy for us. The logs were of small diameter (some less than 8"), wet and covered with slime. Our boots were unable to gain a good purchase on them, and the weight of the equipment we carried did not help. It would have been a serious thing had any of us "gone over," but much to our surprise, we made every one.

We did not escape the jungle unscathed, however, for we were menaced by thorns, tree prongs, and certain vines. Tree thorns are frequently in a vertical position and penetrate the

Members of the expedition negotiating a quebrada crossing. There was so little light in the jungle, that it was only possible to obtain pictures at breaks in the jungle such as this one.

A vine, covered with short thorns. Because it is instinctive to reach for a vine when one trips, these are a real hazard.

skin deeply, forming nuclei for infection. There are some plants that have a poisonous fuzz that penetrates the skin, depositing a drop of acid that produces strong pain and burning. Occasionally, the pain produced by such contact causes cramps or partial paralysis of the affected limb. Further, I would recommend to all jungle travelers that they do not touch the milky sap of trees or rattan palms, for they can be a very effective poison.

At one point in our travel I chanced to stumble, and I reached out and grabbed a vine to regain my balance. Unfortunately, the vine was covered with short thorns that tore the palms of my hands. I resolved not to grab at anything again, and when I stumbled the very next time, I let my body fall against a tree trunk. It turned out to be a thorn tree, and about 20 or so 2-inch thorns skewered my arm. The thorns entered to a depth of about 1/2 to 3/4 inch, right through the cloth sleeve of my shirt. There was a great deal of blood after I pulled my arm away, and the khaki color of my shirt turned crimson. Other than to sprinkle sulfa powder on the wounds there was little I could do. Infection subsequently set in and it was two months after I returned home to the States before my arm recovered fully. Doc Stone was not so lucky. He tripped and fell from a high log, and in the process landed on a thorn tree right on his palms. The resultant infection caused golf ball-sized blisters on the inside of his hands, and he was in poor health the remainder of the trip.

We were wending our way through the jungle on a narrow path, single file when the sixth man in the line called out that the first five men had stepped over a snake, neatly coiled in the center of the path! This caused some consternation since a bite from a poisonous snake is a serious matter in the jungle. Fortunately, the snake turned out to be harmless, but very rare. Win Rayburn captured it but the sight of those who volunteered to hold open the snake bag was something to see! In due time the snake was bagged and we were on our way once again.

After almost 5 hours of hacking our way through the jungle, we neared the Yagua camp. Babalonia went on ahead to announce our presence and explain to the Indians the nature of our visit. It was not safe, of course, to “barge right in.” Those poison darts smart! Babalonia returned with negotiations successfully completed, and we entered the Yagua village. Most of the Indians welcomed us cordially, but a few were openly hostile. A rather large thatched lodge served as a communal sleeping

Grass being dried in a Yagua village. After drying, the grass will be dyed in the traditional ochre color used by the Yaguas.

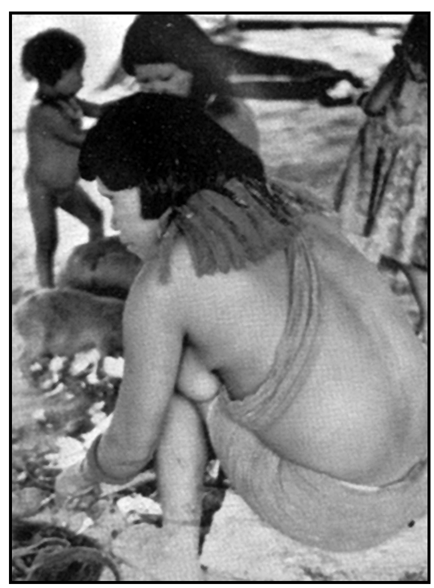
A Yagua woman, preparing cassava root for the noonday meal.

area; smaller non-walled structures were used for cooking, weaving, and other chores. The Yaguas are a very colorful tribe. The men wear skirts of grass with neckpieces and armbands to match. The grass is dyed an ochre color, its length reflecting the status of its wearer in the tribe. The Chief, for example, wore the longest skirt. The women, on the other hand, wear very little. Most have very tightly-bound string around their ankles that cut deeply into the flesh. However, they do paint their faces and wear beaded necklaces. The remainder of their costume consists of a short, orange colored skirt of rough cloth.

Lunch with the Yaguas was an interesting experience as it consisted of cassava root and roasted grub worms. I had already developed a dislike for the cassava root as it is dry and tasteless, but the grub worms were something new. They were cooked in a sort of frying pan in ashes, which gave them a slightly salty taste. The head end was crisp, the abdomen end mushy. They smelled and tasted pretty good, regardless of what some readers may be thinking!

We traded with the Indians and I acquired a Yagua drum, the drumheads being made of the intestine of some animal. This I carefully wrapped in a plastic bag. As it was not safe to stay overnight with the Yaguas, we headed back on our long march through the jungle. It was necessary to get back to the boats before dark, as the trail was poorly marked and dangerous to travel at night.

It rained hard all during our trek, making the crossing of the quebradas very hazardous. We were all at the very edge of physical exhaustion, although there was one "humorous" incident. Jon Krause, who had also secured a Yagua drum, saw the drumheads dissolve in the rain before his very eyes. They were soluble in water! The rain also affected our cameras and it was two days before I could get my movie equipment to work properly again. Two rolls of film were also ruined. Hours later, when every bone in our bodies ached, we reached the canoes. In a driving downpour, we set out for our camp of the previous evening. After we reached camp, the rain stopped. Our guides poured gasoline on some wet brush and



Note the ankle bands on this Yagua woman. The sling is used for carrying her children. Note also the neck-piece.

A group of Yagua indians, posing outside of the communal sleeping lodge. The one near the middle with the longest dress, is the chief.

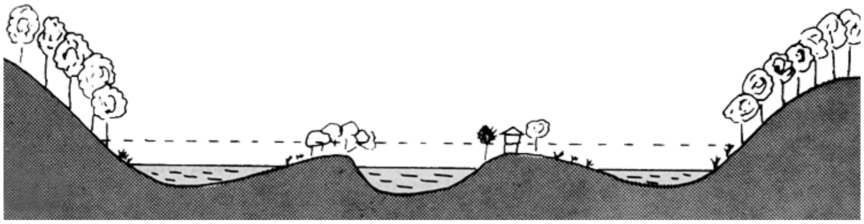
managed to get a fire going. We had very little food left but decided to "go for broke" and finish off what we had, hoping that we could secure food from some natives the next day. Stripping down to my shorts, I managed to dry my clothes by the fire. After a while, our spirits rose and we all felt much better. After all, we had "conquered" Yagua territory!

The first order of business the following day was to return Babalonia to his people. Rather than take two canoes for the job, Pedro was elected to take him home while the rest of us waited, anchored at the junction of the Rio Yacarite and a tributary. During the 2-1/2 hour wait, we watched dozens of freshwater porpoises (genus *Sotalia*) playfully break water all around us - they were present in impressive abundance. These animals, called "buffeo" by the natives, appeared in both light and dark-colored phases. We had the very devil of a time photographing them because we would never know just where they would surface next. To my knowledge, no one had ever made a water analysis of such an Amazon porpoise Blackwater habitat before, so I secured a sample for an abbreviated analysis, the results of which are shown in Table I. The water was extremely acid and soft. Indeed, there was very little dissolved material whatsoever. Although iron was present, the concentration was not as high as that in the Yellow Water streams and rivers I investigated previously. This, however, was to be expected as Blackwater obtains its color from the presence of organic material, notably humus, while Yellow Water obtains its color from the iron-bearing clay that it carries.

TABLE I
Water Analysis: Rio Yacarite, Yagua Territory, Northern Peru, May 1966

pH	5.9
Hardness	less than 10 ppm
Total alkalinity	17.5 ppm
Chloride	0.5 ppm
Iron	1 ppm

Ed Corder and our two native helpers, Arnoldo and Pedro, sorting fish caught with the help of the 30-foot seine. Such large seines are difficult to handle, and often are snagged on submerged sticks or brush.



Diagrammatic representation of a cross-section of a Yellow-water river. The depressions to either side are described in the text. The low water level is shown; the high water level is indicated by the dotted lines (note that the water comes up to the level of the house on stilts.)

place. Only by showing the official the white band across Ed's ring finger where the ring had been, was I able to convince him.

In time, Jon finished with the Commandant and we were free to go. The trip downstream to Leticia was started in a fantastically heavy downpour and we wondered why the canoes didn't fill with rainwater and sink. There was all sorts of floating debris in the river and had we hit any of it, it would have stove in the sides of our frail craft. To keep dry (especially our camera equipment) we used our "space blankets," metalized plastic cloths which could either keep heat in or out, depending upon which side was turned in, but which also was waterproof. Even with all these precautions, our cameras took harsh punishment and I estimate that more than half the camera equipment in the group failed to operate satisfactorily before the trip was over.

There were, however, two thrills I extracted from the trip back to Leticia. A minor triumph was that, after all those days wending our way through the jungle, I had a chance to shave right in the middle of the Amazon River, but the number of cuts and nicks produced as the canoe shot the rapid current just wasn't worth the effort. When the rain let up, however, a beautiful rainbow appeared that arched across the river from one bank to the other. It, in effect, reflected both God and Nature simultaneously, and I doubt that anyone was unaffected emotionally by the sight.

To say that we were a pooped group upon arrival in Leticia is an understatement. After avoiding disaster all throughout our Yagua expedition, Warren Dody managed to fall into the river as he attempted to retrieve his gear

An Amazonian Adventure Part VII

[The Aquarium, August 1968]

At the Peruvian - Columbian border it was necessary to stop for a routine border inspection by Peruvian officials. While Jon was closeted with the Post Commandant, the rest of our group remained with another officer while he recorded certain required information about each of us in a large ledger. I acted as interpreter. One of the things he wanted to know was our occupations. I was going great guns with simple things such as "pioloto," ingeniero," etc., until Ed Corder offered the information that he was a "lithographer"! As a matter of fact, everyone suddenly seemed to sprout strange occupations, the Spanish equivalents for which I couldn't even find in my pocket dictionary (which, by this time, was water-soaked with pages stuck together). Taking the easy way out, I simply gave everyone the title of "ingeniero." This aroused the suspicions of the official who remarked, "How strange, Senor, that for a party of tourists it should contain so many engineers"! To make matters worse, in answering the question of who were married and who were not, I casually remarked that all of our married men wore wedding rings. This worked fine until we got to Ed again and discovered that his wife, Ida, had made him leave his ring at home for fear of his dropping it in the Amazon or some such

From left to right: Duane Walt, Vern Parish and Warren Dody, using the 12-foot seine. Such seines were the backbone of our collecting gear.

from his canoe. Suffice it to say that Warren was neither graceful as he went in, or gracious as he came out! Further, Win Rayburn, Duane Wait and I found that our hotel room had been given over in our absence to an anthropologist who had emerged from a two-month collecting trip in the jungles. However, he offered to share his space with us and we gratefully accepted. The only problem was that his Indian artifacts were strewn over beds, tables, shelves, etc., and we had to relocate them before we could go to bed. Unfortunately, the artifacts harbored hosts of assorted insects, a goodly number of which quickly transferred their attentions to us. Consequently, we were forced to have our beds sprayed with DDT every day at noontime.

Our anthropologist friend was a storehouse of tales as he related his experiences over the years with the natives as, for example, the time his colleague had a piece taken out of his posterior by a piranha while he was skinny-dipping in a Brazilian river. But, the time to return home was drawing near and it was necessary to attend to certain details such as getting our plane refueled. We purchased a number of 55-gallon drums of what was purported to be aviation gasoline but which our copilot swore was 50 % water. It was customary, after filling our fuel tanks, to open a small petcock that led to the bottom of these tanks, to drain the water that (because of its weight) would settle to the bottom of them. This time, Bob had to drain for 45 minutes and even then, he wasn't convinced that all of the water was out. I think he spent one afternoon calculating in which tree we would land should the engines quit on takeoff.

We had, however, one last day in Leticia and so elected to go fishing. Outfitting a canoe with nets, plastic bags, polyfoam boxes, etc., we started off for a tributary of the Amazon, located a few miles west of town. Rain still plagued us but it was light and intermittent. Surrounding Yellow-Water rivers such as the Amazon are depressions that become inundated during the rainy season. The riverbanks are the highest point; beyond them are found flat meadows yielding to a still higher region that is not flooded (see sketch). At the onset of the rainy season these depressions fill with water and form spawning areas for the fishes of the rivers and their tributaries. Our visit to Columbia coincided with the end of the rainy season and consequently, we encountered many young, half-grown fishes as well as adults.

When the bodies of water to be fished are reasonably large, as ours were, the seine forms the backbone of the collector's equipment. Seines are most efficiently worked using three people. One man is stationed at each end of the seine. It is their job to keep the top edge of the seine near the water's surface (by means of floats fastened to the upper edge of the seine), and the bottom edge just touching the bottom of the stream or pool. These two men then carefully, but quickly, work the seine to the shore. The third man creates a commotion in the water, either by stomping with his feet or agitating the water with a paddle or his hands, which causes the fish to dash into the net concealed by this time by the muddy water which results. As soon as the net is pulled up by the end men, the third man scoops the fish, usually with his wet hands, into a floating polyfoam container stationed nearby. We used two sizes of seine: a 10-foot size and a 30-foot size. The latter was very unwieldy in use but it swept a very wide area.

One of the hazards of this sort of fishing is in stepping on a submerged tree trunk or branch of the spiny variety. These spines can go right through the soles of sneakers, and if the fisherman steps on one without any foot gear - well, all I can say is that it right smarts! (And I say this from experience!) Also, one gets the strangest feeling when, standing waist-deep in the water, the seine is pulled up and found to contain a number of piranhas. When this occurs, it is a good time to take a break. ("Yes," say some of my companeros, "for about a year!")

Our work continued for several hours, and we stopped only occasionally for a smoke or some sugar cane. The cane was especially welcome as it supplied both liquids to quench the thirst, and sugar for a quick energy boost. Win Rayburn went digging and found some giant grub worms, but no one was that hungry. I was impressed by the variety of species we were obtaining. Commercial fishermen, of course, tend to fish where but a limited number of species congregate; schools of neon tetras, for example, or large groups of catfish. By fishing a complete pond, we in effect, sampled the whole biotope and found prey and predator alike. Accordingly, in every net full of fishes there would be the smaller tetras and the larger cichlids. Crenicichla, the pike cichlid, appeared to be the major predator in this particular pond. I have made the remark before and I will make it again, however. The average pond biotope containing a mixed "community" of fishes is nothing more than a muddy container of water, devoid of aquatic plants. The vegetation that is present is found only on the banks. Thus, aquarists going for the "natural" aquarium need only about 2 gallons of water and 3 gallons of mud per 5-gallon aquarium; add some silvery, nondescript tetras that wouldn't bring a nickel in the average fish store, and some large predator-type cichlids to eat the tetras, and you have the "natural" tank!

The day to leave arrived and found us packed and ready to go. Transportation to the airport, a mile or so out of town, was via truck, driven by what can only be described as a disciple of the Marquis De Sade. Ruts and holes in the dirt road were ignored; as a wheel would enter one of these holes, our equipment would rise about three feet off the bed of the truck, and we with it. Only by holding onto the truck's railing were we able to stick with it. Overhanging branches acted as a giant scythe, sweeping across the top of the truck and forcing all to duck. Those who weren't quick enough received instant flattop haircuts and headaches. At the airport, our leaving prompted a sort of town celebration (presumably not because they wanted to see us leave but because visitors in their own planes were rare). Columbian customs officials were cooperative and courteous. We stacked our baggage in front of the plane and they examined a small portion of it in a short period of time. We loaded up and said our goodbyes to the many friends we had made during our trip, and who had come to see us off. Mike Tsicka-

Not every net-load holds desirable aquarium fishes. More often than not, nondescript, silvery fishes such as these would form the bulk of the haul.

The fish collected make up a good variety of cichllds, characins, cat-fishes, etc. Here is an unidentified (and new to the hobby) species of *Aequidens* of a rich, golden color.

lis' niece even dressed up in a Columbian airline stewardess' uniform for the occasion, and posed with us in front of our plane for the occasion. A B-25 never did have a prettier "honorary stewardess"!

Our flight across Columbia and Venezuela was without incident. Even the water-laden gasoline caused no trouble. We were required to refuel once on the homeward journey and we selected the Dutch island of Curacao where in former times, the French and the English made the sea boil with their buccaneers, but in modern times is famous for its scenery, its shopping centers, its oil refineries and its friendly inhabitants. Here, located a few miles off the coast of Venezuela, are located 140,000 people of some 45 nationalities living on a sun-soaked, sand-filled island.

It can also be recalled that, in the nearby leeward island of Saint Eustatius, the American flag was saluted for the first time in history, in 1766.

We checked in at a beachside hotel in the capital city of Willemstad, and had hot showers for the first time in three weeks. The city of Willemstad boasts several unusual items including the longest pontoon bridge in the world. When the bridge is open, a free ferry service (operated by the Government) maintains communication for pedestrians across the St. Anna Bay that the bridge spans. The Prins Hendrik Wharf is nothing but a floating supermarket as produce boats are tied there and unload their wares onto concrete stalls on the pier. Housewives shop from the street side in the shade of sails and sail cloths set up on the boats especially for that purpose.

One of the most interesting places we visited was Fort Nassau, built between 1792 and 1796, which overlooks the harbor, the Shell refinery, the blue Caribbean and Willemstad itself. The places where the soldiers used to sleep, drink and sing are now dining rooms, although on the terraces the guns still point their muzzles at the harbor entrance. Another site of interest is the Curacao liquor distillery at the restored estate house, Chobolobo, where a drink may be enjoyed "on the house." It was difficult to make up our minds to leave Curacao, but our funds were running short (indeed, upon my arrival back in the United States I had only $2 in my pocket!) and we had to depart for Miami, our next stop on the trip home.

The landing at Miami was in a terrible rain. How Jon and Bob ever saw the runway is still a mystery to me. As usual, we had to endure the overbearing, rude behavior of U.S. customs officials and inspectors. Rather than send an inspector out to our plane, we were required to rent a trailer, unload everything, and bring it into the customs building where we would spread it out on their shiny, stainless steel tables where it would be superficially examined by bored bureaucracy. I rented the trailer, and two of us went with it out to the plane in the driving rain.

We unloaded most of the duffle bags and got to the Indian artifacts that I knew would be ruined by the rain and the packing-repacking routine. I was pretty annoyed by this time and decided to go back to customs with just the duffle bags, taking the chance that the customs officials would not chance getting their nice uniforms wet. Passing the word to the other fellows, we lined up at the table, one person per duffle bag. Since we hadn't brought all of the luggage back on the trailer, several men didn't have any luggage to stand by. We solved this problem by "lending" luggage to them, and it was pretty funny watching them explain to customs officials, items they didn't know anything about. One of the fellows went through with just an overnight bag and I worried that he would have a hard time explaining how he managed to get by for three weeks on just tube of shaving cream and a toothbrush but the official just waved him on. I don't mean to imply that we did not declare everything that we legally had to declare. This we did and we filled out the necessary forms down to the last dotted-i and crossed-t. What we were fed up with was the callous attitude and disregard for the property of others shown by U.S. Customs. Their "system" was set up for the usual kind of tourist who steps off a commercial flight and magically has his bag appear on the customs table without lifting a finger. Here we had a plane full of equipment, gear, cumbersome souvenirs, and luggage, representing 10 people, that would take four hours to load and unload, and Customs would not alter their precious "rules." Well, they didn't have the inclination to get wet, either, and as it turned out we could have smuggled in an elephant without their being the wiser. At no time during our trip to Aruba, Columbia, Brazil, Peru, or Curacao, did the customs officials of those countries treat us with anything but good humor and courtesy.

Our last sunset on the Amazon, for this trip at least.

The last leg of our trip was to Columbus, Ohio, and we had telephoned ahead to our wives to meet us at the airport. Consequently, the scene at the airport was a madhouse of women, children, dogs, and family cars and station wagons. It took us two hours to unload the airplane but finally, everyone was on his respective way. We all had a lot of catching up to do re family and local news, but the satisfaction of successfully completing our 10,000 mile journey to new worlds was something that each of us would savor for the rest of our lives.

Floating Fish Can Kill

[The Aquarium, June 1968]

NOTE: The article with this title originally appeared in the November 1967 issue of PET SHOP MANAGEMENT. Similar versions were also published elsewhere, including the FTFI TRADER and sundry club magazines. Without doubt, it was the most provocative article of the 1967 aquarium literature "season." The author, Mr. Red Nichols, made three major points in his article, viz., (a) The common practice of floating plastic bags is dangerous and inadvisable; (b) Mixing the water in the bag with the water in the aquarium can result in violent chemical reactions; (c) Rapid temperature changes are safe provided they are within the range of the temperature tolerance of the fish. All three, of course, were rather "radical" statements, at least as far as aquarium traditions were concerned. Mr. Nichols' article was re-printed in the June 1968 issue of The Aquarium, and was followed by a rebuttal of point (a) by Messrs. Tohir and Stratton who reported on a series of experiments that had been suggested by me, the results disproving Nichols' point (a). This in turn was followed by the following editorial critique which focused its attention on points (b) and (c).

When Mr. Nichols' article was originally published, it literally took the aquarium world by storm; the article was subsequently widely reprinted throughout the club publication circuit. One report attempted verification of Nichols' findings with regard to bags but the proffered data reflected a woefully inadequate experimental design (e.g., the bags were half-filled with water, something that no knowing aquarist would ever do), and the statements made were suspect (e.g., "The floated fish soon showed signs of distress and began to die shortly after". If the fish were bagged properly, there was no reason why this should have occurred, floating or no floating.). Consequently, we asked Richard Stratton and David Tohir to conduct a series of valid experiments, the results of which have just been presented.

A number of noted hobbyists have vigorously opposed the Nichols' bag thesis, e.g., Roy Vail (a biologist who has previously contributed to the pages of THE AQUARIUM, and who takes a position as far apart from Red Nichols as it is possible to get) and Don Cook. These aquarists essentially agree with the position of Dr. Warren J. Wisby, Director of the National Aquarium in Washington, D.C., that it is ammonia toxicity that is the biggest killer of tropical fishes, not carbon dioxide. The British aquarium press bordered on looking with amazement at the ideas put forth by Mr. Nichols. In summary then, Mr. Nichols has stirred up the proverbial hornets' nest, and has his supporters and his opponents.

Although Mr. Nichols has stated in his article, "Floating Fish Can Kill", that the water in the bag must be near the danger point before the floating method will result in damaged or injured fish, at other times he has made the blanket statement, "NEVER float fish in plastic bags". Under normal circumstances, Stratton and Tohir have made it clear that there is nothing wrong with the practice of floating. As for those instances where the bag water is fouled, there is little difference between floating and just letting the bag sit by the side of the aquarium. What is overlooked is the fact that very little of a floated bag is immersed in the water anyway (one would have to weigh it down with a brick to make any real difference). But in such extreme cases, neither method is correct. If a dealer (or a hobbyist) receives a shipment of fishes in which some have died, polluting the water and placing the remainder in jeopardy to the extent that quick action is required, the dealer will immediately transfer the fish regardless of temperature difference, and rightly so for it is the lesser of two evils. It remains now, however, to discuss points (b) and (c) of the Nichols' article.

At no time within our experience have we ever observed the "violent chemical reactions" suggested by Mr. Nichols when bag water was added to the aquarium. Indeed, we find it difficult to imagine even some theoretical situation in which this could occur. In some waters, "rust" or ferric oxide has precipitated onto fishes when water of low oxygen content and high ferrous ion concentration has mixed with water of high oxygen content, but the effect on the fishes was minimal. In certain areas of Anatolia, in Turkey, there are springs containing considerable hydrogen sulphide. Many of the fishes are covered with a whitish layer of sulphur as the water is admixed with other waters. Even here, many of these fishes survive. But these are the extent of the "violent" reactions known to occur in nature (other than an outright addition of poisons to the water due to pollution of some sort), and a better term for them would be "dramatic." Both examples would be extremely unlikely to occur under normal circumstances and accordingly, we cannot concur with Mr. Nichols' point (b).

One of the basic principles of fishkeeping has been: Avoid sudden changes in temperature. Thus, the aquarist traditionally not only has been discouraged from adding cold water say at 60°F to a tank containing water at say 75°F, but he has been encouraged to "equalize" temperatures in all fish transfers. Consequently, cautious hobbyists make frequent use of thermometers; more "reckless" types substitute a finger. "Floating" (bags, glass jars, waxed containers, etc.) is a standard practice, most likely because while at the same time satisfying the principle of avoiding sudden temperature changes, it is also simple and convenient. People are most easily persuaded to an action when that action is "convenient."

It is an interesting thing to note, however, how practice is altered as the aquarist gains both experience and confidence. Gone are the thermometers; fingers are "in." Although no aquarist in his right mind would deliberately add 60°F water to 75°F water, the old-timer will add 70°F water to 75°F water without so much as batting a proverbial eyelash. Where the beginner loses sleep worrying about one degree this way or that, the experienced aquarist sleeps soundly over five and even more degrees difference. The "expert" then, adheres to a different principle: Sudden changes in water temperature are safe provided they are within the tolerance range of the species in question. This principle, however commonly followed by experienced aquarists, is never (Mr. Nichols' article being an exception) voiced aloud in the hobby. Two questions are now raised. Is the principle valid? If it is, why has it not been made common knowledge?

Recalling the case of the dealer who transfers his fish suddenly because of some emergency such as polluted water in the bag, the dealer has an additional principle working in his favor: Fish adapt themselves quickly to a rise in temperature, but less easily to a drop in temperature. In the situation previously described, the sudden change is most likely to be from colder to warmer water. This principle has been verified by experimentation and we refer readers to the paper by Allanson, Ernst and Noble ("An Experimental Analysis of the Factors Responsible for Periodic Fish Mortalities During Winter in Bushveld Dams in the Transvaal, South Africa", in BIOLOGICAL PROBLEMS IN WATER POLLUTION, Third Seminar 1962, U.S. Public Health Service, pgs. 293-298) for a typical statement on the subject. In general, however, we must not lose sight of the fact that each species of fish has a thermal tolerance zone in which it behaves in a normal variation in temperature can be harmful to fishes, even if it is of short duration, nevertheless the dangers of sudden variations have been exaggerated in the past. If a fish is in good condition, the probability of its suffering any ill-effects from an abrupt temperature change of up to 10°F, provided the change occurs within the temperature tolerance range of the fish, is very small or nil.

That the above is a reasonable statement is supported by actual experimental work also. In his paper, Cold Death In The Guppy" (BIOLOGICAL BULLETIN, 119, (2), pgs. 231-245, 1960), Ronald Pitkow makes the following observations re *Poecilia reticulata*:

"Among the possible causes of death inherent in cold exposure, two factors may be excluded. The suddenness of a cold exposure is not of itself lethal, for sudden exposures did not cause more mortality than gradual exposures. Moreover, the cooling process per se is not lethal since even repetitive chilling into `primary chill coma' caused no mortality. At a specific cold temperature, the duration of cold exposure is the decisive determinant of lethality rather than the abruptness or repetition of the temperature change."

Thus, we essentially (hedging only because we are specifically assuming healthy fish and allowing for the rare occurrence of those species for which all abrupt variations are harmful) agree with Mr. Nichols' statements in regard to rapid temperature changes and fish.

As to whether this information should be publicized with more vigor throughout the hobby, however, lies the rub. Some people, given an inch, take the whole yardstick. There are many who would misread what Mr. Nichols is saying, and disregard temperature altogether. The result would be sick and/or dying fish. We personally would prefer that the beginner exercise excess caution, rather than balance on the thin line that separates being right from being sorry.

“Floating Fish Can Kill,” we have stated previously, is certainly a provocative article. The stature of its author within the hobby is such that it cannot be ignored. (Roy Vail has stated: “… most of Mr. Nichols’ articles in other publications have been outstanding …“), and indeed, Red Nichols must be given credit for his courage in voicing principles which would be expected to be countered with strong opposition. We have invited Red to comment further on these subjects if he so desires (Mr. Nichols, by the way, has the reputation of being a truly fine person and it must be made clear that only technical points are being debated here, not personalities). Since we have already agreed with his temperature variation point, what would interest us most would be supportive data for the floating bag theory (with details similar to those presented by Messrs. Tohir and Stratton), and some specific examples of those “violent” chemical reactions that have been postulated should two kinds of aquarium water be mixed.

The Worm Turns

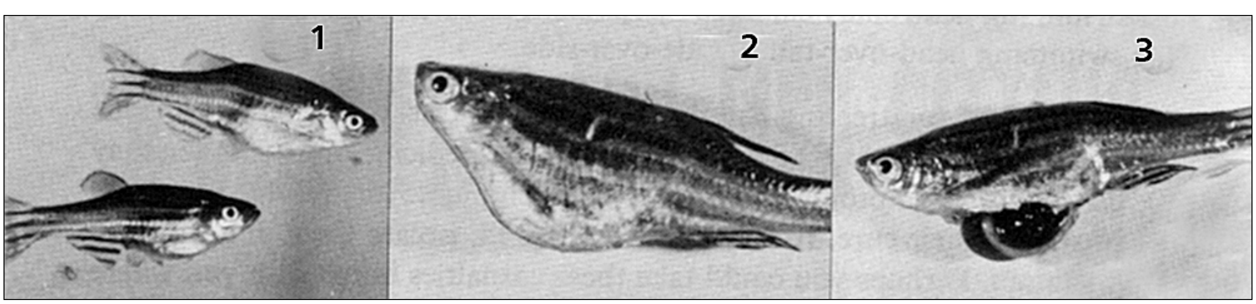
[The Aquarium, August 1968]

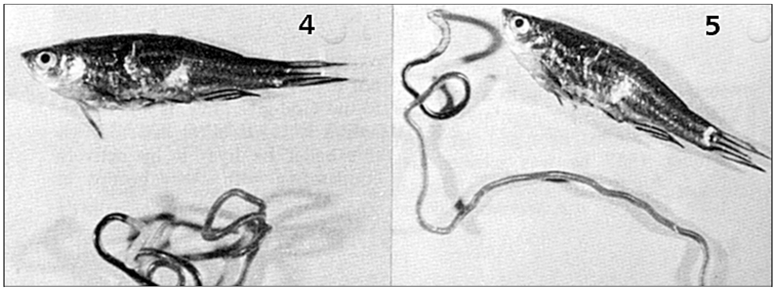
Note: This is one of the articles I wrote under the pseudonym of Harriet Connelly.

When dog bites man or when fish grabs man, these incidents are not usually considered news. Let the situations reverse themselves, however, and they become ammunition for the humorous-events sections of our daily newspapers. A recent experience in the “worm-grabs-fish” category, although interesting, did not appear very humorous, at least to the fish concerned. Some time ago, a local dealer in tropical fishes received a shipment of zebra danios that appeared to be all females. The body of each fish was very plump, indicative of the female sex in this species. However, the contours of the belly line seemed to be extremely lumpy, as if the fish had swallowed some odd-shaped object such as a child’s playing jack (see Figure 1). In addition, the danios forever seemed to be hungry. At this point, it was decided to dissect one of the fish.

After being anesthetized, the fish was laid out on paper where it could be examined closely (see Figure 2). The lumps were clearly seen in this position. A preliminary incision of the ventral area produced a sudden protuberance of the entrails (see Figure 3). At this point, it was confirmed that the fish were infested with some kind of worm (see Figure 4). The worm proved to be a roundworm, the total length of which turned out to be much longer than the fish itself (see Figure 5). Additional specimens were dissected and all contained roundworms, some reaching a length of 5 inches.

Since roundworms are uncommon aquarium-fish parasites, the infestation of several hundred of the zebra danios was surprising. Roundworms infest fishes in a variety of ways but this particular species was found only in

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pools. It seems certain that they became infested through their live food supply, either blood or tubifex (Limnodrila) worms, or one of the numerous small crustaceans that abound in Florida waters. In spite of the large size of the roundworms, the danios continued in apparent good health for over 8 months. During this time they were active, especially during meal times. Since there was no danger of transmitting the worms from one fish to another, owing to the absence of the next host in the life cycle of the parasite, the danios were kept in a community aquarium. Since, also, no cure is known for such a condition, no treatments were attempted. After 8 months, the fish started to die off. Among other things, the large size of the worms had blocked the intestines and made food unavailable to the fish.

the intestines of the fish. No attempt was made to identify the particular species of roundworm, as this is a matter best left to specialists. Dr. H. H. Reichenbach-Klinke discusses but one genus of roundworm in his book, viz. *Capillaria*, but these are very small roundworms often referred to popularly as "hairworms." A shorter discussion but covering more genera can be found in Van Duijn. This author refers to one roundworm, *Ichthyonema*, as being characterized by its red color and being found in the belly region of the host fish. Probably the best review of nematode ("roundworm") infestations of aquarium fishes can be found in Amlacher, but even his account leaves much to be desired. (The Reichenbach-Klinke and Amlacher books are in German, the Van Duijn book is in English.)

The damage done to fishes by roundworms varies with the size of the worm and its particular life cycle. Some roundworms develop as larvae within the body of the host fish, and subsequently form cysts. The cysts may cause trouble internally. Other worms may, as in this case, live as adults within the host. If the worm leaves the fish by boring through tissue and organs, much harm can be done by the wounds so made. Since an intermediate host is usually involved, roundworm infestation is not a prevalent aquarium malady. However, fishes become infested by eating live foods contaminated with worm larvae, or by eating fishes already infested with worms or larvae.

Upon inquiry, it was discovered that the zebra danios in question originated from a Florida hatchery where they were kept in outdoor

Other aquarium fishes have been reported to contain roundworms, including angelfish, several Brazilian species of cichlids and characins, imports of the neon tetra (*Hyphessobrycon innesi*) from Peru, some *Corydoras* species, and the electric catfish, *Malapterurus electricus*. We can now add *Brachydanio rerio* and, undoubtedly, additional species will be unlucky enough to be included in this list in the future.

Malachite Green

[The Aquarium, September 1968]

Note: This is one of the articles I wrote under the pseudonym of Harriet Connelly.

This dye, malachite green, is one of the compounds used to prevent or 1 combat the effects of pathogenic organisms on fish. It was first brought to the attention of the aquarium hobby in 1952 as a result of a report by the U.S. Fish and Wildlife Service on preliminary experiments to prevent fungusing of pike eggs in hatcheries. The pike eggs, hatched in running

TABLE I					
Influence of malachite green on survival of fish. Each test used five fish. "D" denotes that some or all died; "S" denotes that all survived. The last column is the average survival time, in minutes, when the fish were left in the concentration indicated.					
Concentration	**Exposure Time In Minutes**				
	10	**20**	**40**	**80**	**Unlimited**
1:80,000	S	D	D	D	89
1:160,000	S	S	D	D	126
1:320,000	S	S	D	D	156
1:640,000	S	S	S	D	189
1:1,280,000	S	S	S	S	225
1:2,560,000	S	S	S	S	324

water, were treated for one hour with the chemical at a strength of 1:200,000. The eggs turned green but were not adversely affected. Treated eggs gave 100% larger hatches than untreated ones. Actually, some earlier work on salmon eggs had been done in 1949 at which time several chemicals were investigated, including formalin as well as malachite green. The conclusion was that malachite green was very effective and had the greatest margin of safety in use. The concentration used also was 1:200,000, for a period of one hour. Subsequently, successful applications have been reported involving the occurrence of fungi, bacteria, and protozoa. The reported treatments vary from a dip-bath of ten seconds in a 1:5,000 concentration, to an exposure for several days in a 1:700,000 concentration.

Three questions naturally arise with regard to the use of malachite green: (a) Is it effective? (b) Is it safe? (c) What is the proper dosage? Unfortunately, these questions are not easily answered because there exists a complicated relationship that might be referred to as the fish-bath-chemical-pathogen “quadrangle.” In other words, the variables are the species and age of the fish involved, the time-concentration dosage, the properties of the aquarium water, the grade of chemical used, and the type of pathogen (i.e., disease organism) involved.

To illustrate the time-concentration effect, Table I is helpful. These experiments were performed on immature sand whiting (*Sillago ciliata*), ranging in size between 10 and 25 cm, contained within plastic-lined wooden tanks of

TABLE II			
Influence of body size of fish and temperature on toxicity of 1:80,000 malachite green solutions. Figures indicate survival time in minutes. Each experimental condition represents five fish.			
Temperature	**Large**	**Small**	**Average of Large and Small**
14.8°C	109.8	95.4	102.2
17.8°C	87.2	85.8	86.5
18.0°C	79.0	77.4	78.2
Average	92.0	86.2	

2-1/2 gallon capacity, 5 fish to a tank (these are marine fish and were, of course, kept in salt water). The Table shows that safety is related to both exposure time and concentration. It is meaningless, therefore, to talk merely about concentration.

Another interesting experiment with these sand whitings involved a study of body size of fish and temperature on the survival time (see Table II). Although the results are not statistically significant, as temperature increased, survival time decreased for both "large" (mean weight 131 grams) and "small" (mean weight 14 grams) fish. Similarly, the survival time for large fish was greater than that for small fish at all temperatures studied.

Water temperature is an important factor in any disease control scheme. (The temperature is not limited to dyes. A distinct increase in toxicity of insecticides, for example, has been noted in other investigations.) Although body size is a factor, the differences to be expected are not important enough to warrant special care in disease control schemes using malachite green.

A great deal has been said about the type of malachite green used in the control of fish diseases (especially with regard to the so-called "zinc-free" dye). Two types of malachite green are commonly available, viz., a chloride salt and an oxalate salt. No significant differences, however, have been found between the two. As far as purity of the dye is concerned, this is apparently a needless concern. The typical impurity content of commercially available malachite green varies from about to 5 %. Even if these impurities are toxic to fish, the quantities of dye employed are such that the impurity quantity is largely irrelevant.

Aquarists familiar with malachite green know hat the bluish color of its solutions gradually fade. Among other things, the degree of decolorization or fading increases with increasing pH. Experiments to determine whether fresh or decolorized solutions are more toxic have generally proved inconclusive. There seems to be no significant difference. With regard to bacteriostatic activity, i.e. the ability to slow down the growth and reproduction of bacteria, however, fresh malachite green demonstrates a stronger effect than the decolorized solutions. The dye, fresh or faded, has relatively little bactericidal (i.e., killing) effect on either gram-negative pseudomonad bacteria or gram-positive coccus bacteria. Typical results are shown in Table III.

Table III shows that, although malachite green has no bactericidal effect, it does slow down (or stop) growth, and that fresh solutions are

TABLE III

Results of tests on bactericidal and bacteriostatic activity of 1:80,000 malachite green solutions on two species of marine bacteria.
A: Number of organisms/ml immediately after addition of dye.
B: Same, 20 minutes after addition. Growth rate is in generations/hour.

	Pseudomonad			Coccus		
	Viable Counts		Growth Rate	Viable Counts		Growth Rate
Treatment	A	B		A	B	
Fresh	360,000	460,000	no growth	540,000	620,000	0.16
Faded	420,000	470,000	0.38	560,000	540,000	0.22
Control	430,000	222,000	0.57	500,000	unchanged	0.55

better than decolorized solutions (which, in turn, are better than no dye at all). It should be noted also that other investigators have found malachite green to inhibit, but not kill, the growth of the gram-negative fish pathogen, Vibrio piscium, commonly infecting rainbow trout.

Malachite green, however, is not the only member of this general group of dyes (i.e., the triphenyl aminomethane group) used for the treatment of fish diseases. Both crystal violet and brilliant green are very effective bacteriostatics to gram-positive bacteria, and somewhat less so to gram-negative bacteria. This implies that a much broader spectrum of fish pathogens could be reached with a mixture of these dyes than with the single dye, malachite green, Indeed, a strong triple dye mixture consisting of 0.8 grams of malachite green, 0.8 grams of brilliant green, and 0.6 grams of crystal violet in 10 liters of water has proved satisfactory in checking bacterial infection when the fish were immersed in the solution for 10 seconds two or three times a week. This works out to a concentration of 1:12,500 for the malachite green and brilliant green, 1:16,700 for the crystal violet, and a total of 1:45,500 for all three together.

In summary:

1. The safety of malachite green is a function of both time and concentration, i.e., use dilute solutions in long immersions or concentrated solutions in the form of short dips.
2. The toxicity of malachite green is a function of temperature, i.e., the higher the temperature, the greater the toxicity.
3. Body size of the fish, type of malachite green and impurities are of much less importance.
4. Fresh malachite green solutions are more effective than older, decolorized solutions; toxicity, however, is about the same.
5. Malachite green is not a bactericide but is effective as a bacteriostatic agent.
6. A mixture of malachite green, brilliant green and crystal violet is very useful in the treatment of bacterial fish diseases as a broad-spectrum remedy when the exact nature of the infection is not known.

Anableps, The Four-eyed Fish

[The Aquarium, October 1968]

In 1608, Robert Harcourt of Stanton Harcourt in the county of Oxford, England, set sail for the Canaries and the coast of Guinea. After a long voyage, they took possession of **"a goodly country, and spacious Empire, on the north part bounded with the sea, and the great river of Orenoque ...on the east and south parts with the famous river of Amazones, and on the west part with the mountains of Peru."**

As Harcourt told it, there they found **"... a rare fish called Cassoorwa, which hath in each eye two sights, and as it swimmith it beareth the lower sights within the water, and the other above; the ribs and back of this fish resemble those parts of a man, having the ribs round and the back flat, with a dent therein, as a man hath; it is somewhat bigger than a Smelt, but far exceeding it for dantie meat; and many other sorts there be most excellent."**

From the description, it is believed that this account is one of the earliest of the four-eyed fishes, genus *Anableps*. Four-eyed fishes have been known to science for many years as a consequence of the peculiar formation of their eyes. Anatomists in particular have been interested and in 1803, the German anatomist, Schneider, very accurately described the structure of the eyes of these fishes. Aquarists, however, are not very familiar with the genus - partly because of their scarcity, partly because of their relatively high cost.

In 1936, Albert S. Pincus collected six specimens of *Anableps anableps* (= *Anableps tetrophthalmus*) along the banks of the Esse-

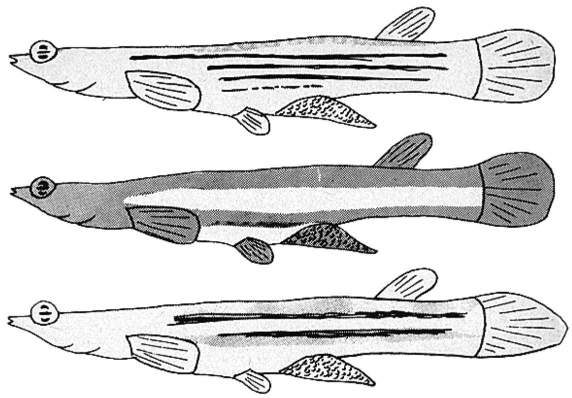

FIGURE 1: From top to bottom: *Anableps anableps, A. dowei* and *A. microlepis*.

quibo River in British Guiana and delivered five specimens alive to the New York Zoological Society. Also in 1936, Mr. T. MacDougall obtained several specimens of *Anableps dowei* (variously spelled "*dowie*" and "*dovii*") from Vera Cruz, Mexico, and shipped them to the New York Zoological Society. In general, then, *Anableps* is native to Mexico, Central America, and northern South America. There is another species, *Anableps microlepis*, found from Brazil to Surinam, but it is not known whether aquarists have ever seen it in captivity. Figure 1 and Table 1 summarize the differences among these three species.

By way of introduction, the word, *Anableps*, is derived from the following Greek roots:
ana - "up" or "upward"
blepis - signifying "look"

With regard to taxonomy, the four-eyed fishes are related to the killifishes, Cyprinodontidae, and the livebearers, Poeciliidae, and are given their own family, Anablepidae.

The natural habitat of the four-eyed fishes is generally along muddy riverbanks that are washed occasionally by ocean tides (the New York Aquarium used 6 parts fresh water to 1 part pure ocean water in keeping them - my own specimens were kept in moderately hard water, on the alkaline side). Although they have been taken from streams located miles from any ocean, the water itself was still alkaline. One of the difficulties in keeping *Anableps* in the past stemmed from these unusual brackish and/or alkaline water requirements.

The eye of *Anableps* is, of course, very interesting. Each eye is divided by a dark band into upper and lower sections. As Robert Harcourt indicated, the lower eye is adapted for vision in water, the upper for air. Furthermore, each pupil is divided into two parts by an ingrowth of the iris (see Figure 2). Human eyes have two pairs of lenses since, for distant viewing, a lens must be well in the back of the cornea, and vice versa for close viewing. With only one pair of lenses, *Anableps* accommodates both near and far objects by virtue of egg-shaped lenses—the long axis of each is simply directed into the water, the short axis into the air. The position of the eye provides that it receives light rays through both axes at the same time (see Figure 2). Since the air-eye is not equipped with tear glands to keep it moist, *An-*

TABLE I

Anableps anableps	*Anableps dowei*	*Anableps microlepis*
Series of 3 to 5 dark, narrow stripes on the sides of the body, two or three of which are usually more distinct Series of 3 to 5 dark, narrow stripes on the sides of the body, two or three of which are usually more distinct and complete than the others. Two of the bands are sometimes joined above the vent.	Upper half of body dark brown; below this is a broad yellow band separated from the yellow of the ventral area by a brown band.	Two narrow, longitudinal brownish bands on the sides, separated by a yellow area. In some specimens the bands are very faint or absent completely.

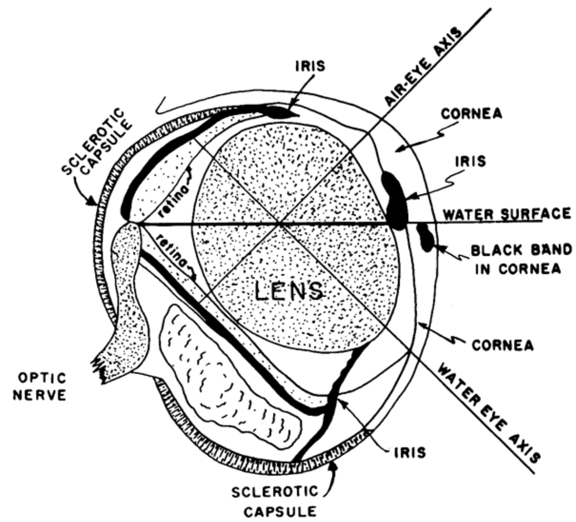

FIGURE 2: The eye of *Anableps*.

ableps must dip its head below the surface of the water frequently.

The lower pupil is shaded by a double shade formed by the projecting parts of the iris (Figure 3 shows the lower pupil screen in its normal position). It is believed that this double screen prevents surface reflections from striking into the lower pupil. Thus, the screen prevents the water-eyes from looking anywhere but downward, perchance to detect predators. Then too, the air-eyes are fine adjuncts when swimming in muddy waters, and when one vision must not interfere with the other.

But even if *Anableps* didn't sport these strange organs of vision, it would still make the aquarist's hall of fame on the basis of mode of reproduction alone. It is not that the bringing forth of its young alive is odd (although the fact that *Anableps* broods usually number only 1 to 5 young at a time, and that the young are about a third the size of the parents is cause for some eyebrow lifting!) but rather the stringent requirements which have to be met before copulation can take place. The genital opening in the female *Anableps anableps* is covered by a special scale called a "foricula." This foricula is located on the keel of the fish and is hinged on one side, i.e. either on the right side or the left, varying from one individual to the next (see Figure 4). As a result, the approach by a male must be made on the appropriate side of the female. Unlike the male guppy, however, which can turn its intromittant organ (gonopodium) either to the left or to the right equally well, the male *Anableps* can only turn his in one direction, i.e. left or right only (see Figure 5). Thus, to permit sexual union, a "right-handed" male *Anableps* must mate with a "left-handed" female, and vice versa! (Some authors say this is not so as far as the female is concerned. It is true that both "left-handed" and "right-handed" males have been seen making overtures to a single female, but the opening in the female is under the foricula and either to one side or the other. It is difficult to see how true union could take place if the approach was not from the correct side.) Females of *Anableps dowei* and *A. microlepis* do not have a foricula scale but their openings are situated in a groove or fold of which the scales of one side overlap those of the other. The effect, therefore, is quite the same.

The first *Anableps* I had an opportunity to scrutinize carefully were in the hands of a dealer. Unfortunately, both fishes (he had a

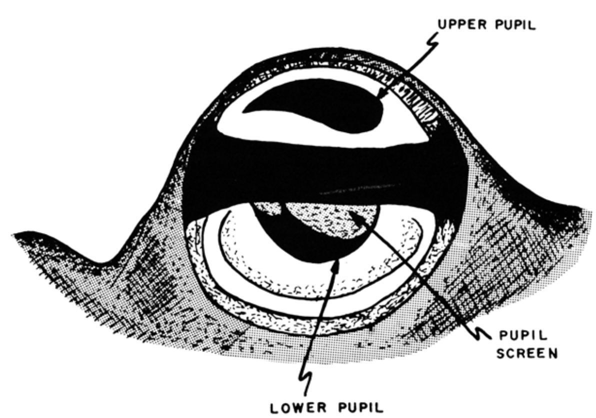

FIGURE 3: The lower pupil of the *Anableps* eye is shaped by a screen. This prevents reflections from the surface from striking into the lower pupil.

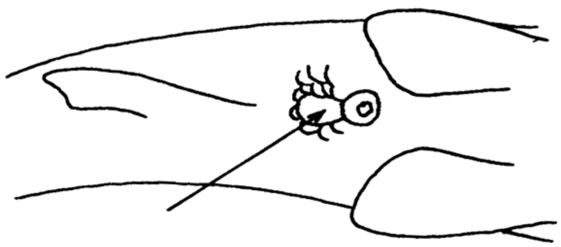

FIGURE 4 A: view of the ventrum of a female *Anableps*, showing the foricula scale (arrow).

pair) jumped out of their tank one night, and were discovered the next day dried out and quite dead. As a result, when I obtained a pair of *Anableps anableps*, they immediately were placed in an 8-gallon aquarium that had a snug-fitting cover. Some aquarists have had little trouble in this regard but my advice is to take these simple precautions. Collectors of these fishes in the wild have made reference to spectacular jumps of specimens in order to avoid capture.

Surprisingly, there is no difficulty whatsoever in feeding *Anableps*. As a matter of fact they scoop floating dry food from the surface of the water faster than the average housewife can scrape crumbs from a piece of burnt toast. In feeding from the surface, *Anableps* arches its back, poking its head partly above the water.

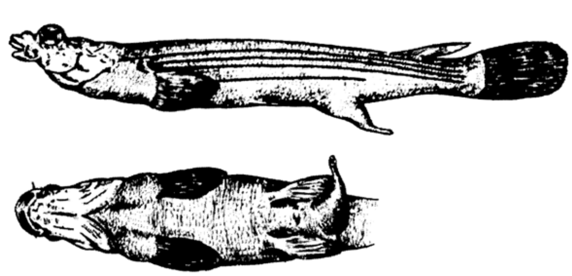

FIGURE 5:
Top: Side view of *Anableps*, showing the gonopodium. Below: A look at the ventrum of the male. This is a sinistral male, i.e., the gonopodium can only be swung to the left.

The few attempts that were made to force these fishes to feed from the bottom were unsuccessful, although some aquarists have managed it.

In community aquaria, they are quite amicable although one must remember that these are rather large fishes (about 6 to 8 inches at maturity) and, as such, are capable of swallowing smaller fishes. My pair at a length of 2 inches did not molest fishes the size of adult zebra danios, but baby guppies disappeared rapidly. In general, the fish is found stationary at the water's surface but at feeding time, it splashes much water in its attempts to be first.

The gonopodium of the male *Anableps* is, like that of other livebearers, merely a modification of the anal fin. It is quite bulky, however, and scaly (see Figure 5). Under ideal conditions, female *Anableps* will deliver young about twice a year. Obviously, there is no danger of a "population explosion" with the four-eyed fish! The very large newborn young (nearly two inches long) are peculiar in themselves. Some fishes such as the sail finned fish (*Polypterus*) are born with a number of exposed blood vessels about the gills (actually these organs are external gills), but *Anableps* is even more unusual. A feature of the embryo is its abdominal pouch or bag, containing the intestines (of *Anableps*). The surface of this pouch is covered with numerous blood vessels into which enters the food supply drawn from the portion of the egg remaining with the embryo inside its membranous egg envelope. After the egg envelope ruptures within the ovarian cavity, the blood vessels are absorbed and the bag walls become thinner. After the embryo has nearly completed its prenatal development, the intestines gradually withdraw into the abdomen and the pouch shrinks, shrivels up and is absorbed or otherwise destroyed. This leaves a cleft, however, and the fry is born with its ventral area open in the form of a slit extending from gills to vent. The viscera are not exposed, however, and the slit closes in a few days. Finally, it is covered by scales and obliterated.

In the newborn *Anableps*, the eyes are normal at first. The division by the dark horizontal band into upper and lower sections takes place only several weeks after birth. The parents are not cannibalistic; perhaps due to the great size of the young and, like their parents, the fry (if you can call them that!) will take foods normally reserved for full-grown fishes. Truly, *Anableps* is a remarkable fish, perhaps the most remarkable of all aquarium fishes. You would have to work some to convince me otherwise!

A New Classification of Fishes Part I

[The Aquarium, October 1968]

Until recently, the most widely accepted classification of fishes was that of Berg, published first in 1940. Berg's classification closely followed that of Regan (1929) which, in turn, reflected the basic ideas of Gill (1872 and 1893). Thus, when one really gets down to it, we are talking about a classification system whose roots go back 70 to 90 years. In 1966, a new classification of living fishes, incorporating the most modern concepts available, was published as a joint effort of four very distinguished ichthyologists: Dr. P. Humphry Greenwood of the British Museum of Natural History, Dr. Donn E. Rosen of the American Museum of Natural History, Dr. Stanley H. Weitzman of the Smithsonian Institution, and Dr. George S. Myers of Stanford University. Their "paper," an imposing volume of some 455 pages, appeared under the name, "Phyletic Studies of Teleostean Fishes, With A Provisional Classification of Living Forms" (Bulletin of the American Museum of Natural History, Vol. 131: Article 4, 1966). (By "teleostean" is meant the more advanced types of bony fishes, i.e. no sharks, skates or rays. This would include practically all aquarium fishes with the exception of some very primitive types such as gars, lungfishes, and the Polyteridae of Africa.) We have taken the

TABLE I

DIVISIONS AND SUPERORDERS OF LIVING FISHES

	Orders	Families	Aquarium Families
Division I			
Elopomorpha	3	22	0
Clupeomorpha	1	4	0
Division II			
*Osteoglossomorpha	2	6	4
Division III			
Protacanthopterygii	4	51	2
*Ostariophysa	2	57	37
Paracanthopterygii	5	30	0
*Atherinomorpha	1	16	10
*Acanthopterygii	12	216	22
Totals	30	412	75

TABLE II
DIVISION II ORDERS, SUBORDERS AND FAMILIES

Superorder Osteoglossomorpha
- **Order Osteoglossiformes**
  - **Suborder Osteoglossoidei**
    - ***Osteoglossidae (OS-TEE-OH-GLOSS'-EH-DEE)**
    - ***Pantodontidae (PAN-TOE-DON'-TEH-DEE)**
  - **Suborder Notopteroidei**
    - **Hiodontidae (HY-OH-DON'-TEH-DEE)**
    - ***Notopteridae (NO-TOE-TER'-EH-DEE)**
- **Order Mormyriformes**
  - ***Mormyridae (MOR-MY'-REH-DEE)**
  - **Gymnarchidae (GYM-NARK'-EH-DEE)**

lead and adopted the Greenwood et al. classification as the standard for the magazine. It is time, therefore, for aquarists to familiarize themselves with this very important development.

Unfortunately, classification is not a very easy subject for the average hobbyist. Most of the scientific terms used are real "jawbreakers," and unless a classification relates to the aquarist and the hobby directly, it quickly becomes boring. We propose, therefore, to examine this new classification in a step-by-step fashion, ignoring those parts that have little relevance to the hobby, and emphasizing those that do. For the most part, however, the classification will be examined solely from the freshwater hobbyist's point of view in order to keep the numbers of families involved to a minimum. We intend, at a later date, to devote a special series to the problems of salt-water fish nomenclature, classification, and identification.

Table I summarizes the Divisions and Superorders of living fishes. In order to provide some indication of both scope and relevance, the number of Orders within each Superorder, the number of Families within each Order, and the numbers of Families that could be considered as "aquarium Families" (i.e. those that contain either a reasonably significant number of aquarium species, species of special interest, or species of considerable aquarium importance) are indicated also. In general, "game fishes" will not be included except insofar as some may be kept as aquarium specimens. Because this definition is somewhat flexible, the number of such Families given is only an approximate figure in most cases. In any event, it is clear from Table I that aquarists are concerned primarily with Divisions 11 and III, and the four Superorders asterisked.

Division I contains principally marine fishes, especially those of eel-like form. They do not, therefore, offer much in the way of interest to the majority of aquarists. Division II is another matter, however. This is a somewhat primitive group of fishes of distinct interest to the aquarium hobby. Because of this, the Division is summarized completely in Table II (including the pronunciation of all Family names), and each of its Families is sketched in Figure 1. The aquarium fishes of Division II (which are contained within the Families asterisked in Table II) are specialist's species, found mostly in the tanks of only the most advanced aquarists. Thus, in the Osteoglossidae, we find the aruana; in the Notopteridae, the African knife fishes; and in the Mormyridae, the elephant fishes. It is obvious that the bulk of our aquarium fishes reside in Division III, and this

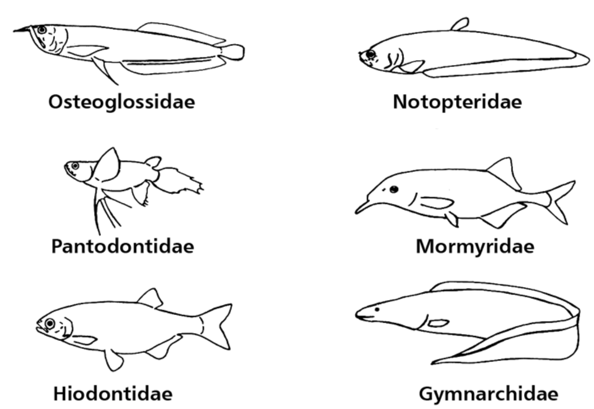

FIGURE 1: Families of Osteoglossomorpha

rather extensive assemblage of fishes will be discussed in detail in subsequent installments of this series.

rid of his *Belonesox*. What fools some mortals be!

A New Classification Of Fishes - Part II

[The Aquarium, November 1968]

Out of the approximately seventy-five families of fishes from which our aquarium specimens are obtained, about 95% are to be found in Division III. Most of these are found in three of the five Superorders of the Division, viz. Ostariophysa (carps, characins and catfishes), Acanthopterygii (cichlids and bubble nesters), and Atherinomorpha (killies and livebearers). A survey made by the author to determine the percentage of the total number of species of aquarium fishes in these three Superorders resulted in the figures 47%, 28% and 16% respectively, leaving 9% of the total number of species scattered about the other Superorders of Divisions II and III.

The one Superorder in Division III that contains no aquarium Families is the Paracanthopterygii, a collection of mostly marine fishes, particularly deep-sea forms, but which also includes our native blind cavefishes of the Family Amblyopsidae. Another Superorder that can be treated briefly is the Protacanthopterygii, an assemblage of more or less slender, predatory fishes such as the salmon and the pike. Included within, however, are two Families of passing aquarium interest: Umbridae (**UM'**-BREH-DEE) and Phractolaemidae (FRAK-TOE-**LEE'**-MEH-DEE). The former contains the mud minnows (*Umbra*), and the latter contains the rather peculiar, archaic-looking African fish, *Phractolaemus ansorgei*. Since mud minnows are kept only by the most avid of native fish fanciers, and because *Phractolaemus* is both rare and expensive, the Superorder is of little significance to the aquarium hobby.

The Superorder Atherinomorpha, shown in Table I together with pronunciations of the Family names, is of considerable importance, however, as it contains both the killifishes and the livebearers. The Suborder Exocoetoidei is of limited interest but does possess the Family containing the halfbeaks, Exocoetidae (which replaces Hemiramphidae), and the Family containing certain very rare aquarium garfishes such as *Potamoraphis* and *Xenetodon*, i.e., Belonidae.

Of great interest is the Suborder Cyprinodontoidei, containing six aquarium Families (all aquarium Families in Table I are asterisked).

TABLE I

SUBORDERS AND FAMILIES OF ATHERINOMORPHA

Suborder Exocoetoidei
*Exocoetidae (EX-OH-**SEE'**-TEH-DEE)
*Belonidae (BEL-**LONE'**-EH-DEE)
Scomberesocidae (SCOM-BER-ER-**SOWS'**-EH-DEE)

Suborder Cyprinodontoidei
*Oryziatidae (OH-RYE-ZEE-**AT'**-TEH-DEE)
Adrianichthyidae (A-DREE-IN-ICK-**THY'**-EH-DEE)
Horaichthyidae (HOR-AH-ICK-**THY'**-EH-DEE)
*Cyprinodontidae (SY-PRIN-OH-**DON'**-TEH-DEE)
*Goodeidae (**GOOD'**-EH-DEE)
*Anablepidae (AN-AH-**BLEP'**-EH-DEE)
*Jenynsiidae (JEN-IN-**SY'**-EH-DEE)
*Poeciliidae (PEE-SILL-**EYE'**-EH-DEE)

Suborder Atherinoidei
*Melanotaeniidae (MEH-LAN-OH-TEH-**NYE'**-EH-DEE)
*Atherinidae (AH-THER-**RIN'**-EH-DEE)
Isonidae (EYE-S**ON'**-EH-DEE)
Neostethidae (NAY-OH-**STETH'**-EH-DEE)
Phallostethidae (FAL-LOW-**STETH'**-EH-DEE)

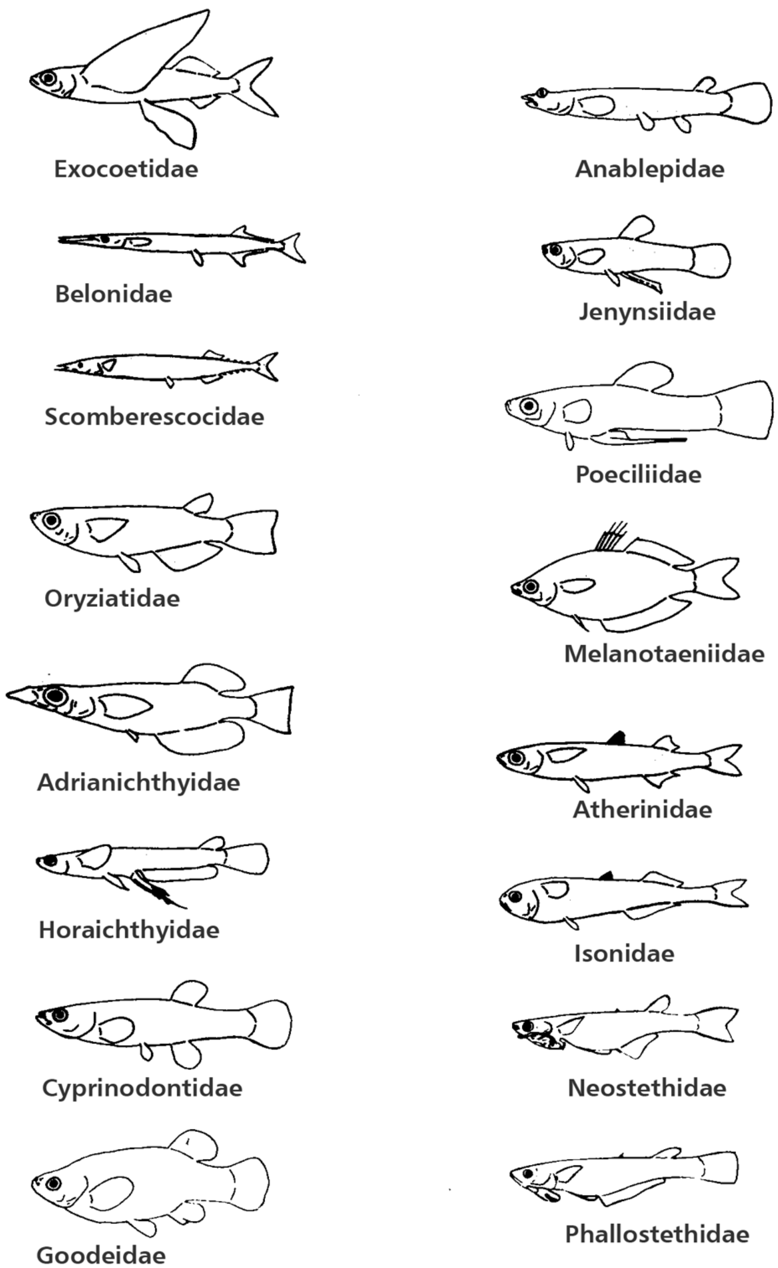

FIGURE 1: FAMILIES OF ATHERINOMORPHA

Going down the list we find the medakas (Oryziatidae), the killies (Cyprinodontidae, a family which includes the previously-separated Fundulidae, Orestiidae and Empetrichthyidae), some peculiar Mexican livebearers occasionally seen in aquaria (Goodeidae), the four-eyed fishes (Anablepidae), the peculiar and rarely seen *Jenynsia* (Jeynsidae, which includes the previously-separated Fitzroyiidae), and the livebearers (Poeciliidae, which includes the previously-separated Tomeuridae). The important Families, however, are Cyprinodontidae and Poeciliidae - the killies and the livebearers.

The Suborder Atherinoidei contains two Families of much more limited interest. The Family Melanotaeniidae contains the familiar Australian rainbow fishes (*Melanotaenia*), and the Family Atherinidae (including the previously-separated Pseudomugilidae) that houses certain Australian and Celebes fishes such as *Telmatherina* and *Pseudomugil*. Sketches of all of the Families in Atherinomorpha are shown in Figure 1.

A New Classification Of Fishes Part III

[The Aquarium, December 1968]

The most important Superorder of all is Ostariophysi, a collection of predominately freshwater fishes that includes, as we have stated, about 47% of all aquarium species. The Superorder consists of two Orders, viz., Cypriniformes and Siluriformes, with the former further subdivided into three Suborders (Table I). Because the Suborder Characoidei is comprehensive, we have listed its Families (aquarium Families asterisked), together with pronunciation and typical genera, in Table II. The suborder is further summarized in Figure 1. It should be noted that the Family Characidae contains the previously separated Families Crenuchidae,

TABLE I
ORDERS AND SUBORDERS OF OSTARIOPHYSI

Order Cypriniformes	Typical Fishes
Suborder Characoidei	Tetras
Suborder Gymnotoidei	South American knife fishes
Suborder Cyprinoidei	Carps, barbs, minnows
Order Siluriformes	Catfishes

TABLE II
ORDERS AND SUBORDERS OF OSTARIOPHYSI

Order Cypriniformes	*Typical Fishes*
Suborder Characoidei	Tetras
Suborder Gymnotoidei	South American knife fishes
Suborder Cyprinoidei	Carps, barbs, minnows
Order Siluriformes	Catfishes

Acestrorhynchidae, Serrasalmidae, Tetragonopteridae, Creagrutidae, and Glandulocaudidae. This single Family alone contains about 11% of the total number of aquarium species!

Going down the remainder of the list of aquarium Families in Characoidei we find two important Families, Lebiasinidae (i.e., pencilfishes—the Family includes the previously-separated Nannostomidae) and Gasteropelecidae (hatchetfishes). Most of the remainder of the aquarium Families contain certain popular fishes, interest in Curimatidae and Citharinidae being quite limited, with only the diehard oddball specialist interested in the fierce predators of Erythrinidae and Ichthyboridae.

This brings us now to the other two Suborders of Cypriniformes, summaries of which are given in Table III (aquarium Families asterisked) with Family sketches shown in Figure 2. The Suborder Gymnotoidei includes the electric eel and the sundry South American knife fishes, all of which are aquarium specimens of sorts.

TABLE III
FAMILIES OF GYMNOTOIDEI
AND CYPRINOIDEI
Suborder Gymnotoidei
*Gymnotidae (JIM-**NO'**-TEH-DEE)
*Electrophoridae (ELEK-TRO-**FOR'**-EH-DEE)
*Apteronotidae (AP-TER-OH-**NO'**-TEH-DEE)
*Rhamphichthyidae (RAM-FICK-**THY'**-EH-DEE)
Suborder Cyprinoidei
*Cyprinidae (SY-**PRIN'**-EH-DEE)
*Gyrinocheilidae (JYE-RIN-OH-**KYE'**-LEH-DEE)
Psilorhynchidae (SYE-LOW-**RIN'**-KEH-DEE)
*Homalopteridae (HOMA-LOP-**TER'**-EH-DEE)
*Cobitidae (CO-**BYE'**-TEH-DEE)
Catostomidae (KAT-TOE-**STOW'**-MEH-DEE)

TABLE IV
FAMILIES OF THE ORDER SILURIFORMES
Diplomystidae (DIP-LOW-**MIS'**-TEH-DEE)
Ictaluridae (IK-TAL-**LUR'**-EH-DEE)
*Bagridae (**BAG'**-REH-DEE)
Cranoglanididae (KRAN-OH-GLA-**NYE'**-DEH-DEE)
*Siluridae (SILL-**LUR'**-EH-DEE)
*Schilbeidae (SHIL-**BEE'**-EH-DEE)
*Pangasiidae (PAN-GAS-**EYE'**-EH-DEE)
Amblycipitidae (AM-BLEE-SIP-**PIT'**-TEH-DEE)
Amphiliidae (AM-FILL-**EYE'**-EH-DEE)
Akysidae (AK-**KYE'**-SEH-DEE)
Sisoridae (SYE-**SORE'**-REH-DEE)
*Clariidae (KLAR-**RYE'**-EH-DEE)
*Heteropneustidae (HET-TER-OH-**NEWS'**-TEH-DEE)
*Chacidae (**KA'**-SEH-DEE)
Olyridae (OH-**LYE'**-REH-DEE)
*Malapteruridae (MAL-LAP-TER-**REW'**-REH-DEE)
*Mochokidae (MOE-**KOW'**-KEH-DEE)
Ariidae (AR-**RYE'**-EH-DEE)
*Doradidae (DOOR-**RAY'**-DEH-DEE)
*Auchenipteridae (AW-KEN-NEH-**TER'**-EH-DEE)
*Aspredinidae (AS-PREH-**DIN'**-EH-DEE)
Plotosidae (PLO-**TOE'**-SEH-DEE)
*Pimelodidae (PIM-MEL-**LOW'**-DEH-DEE)
Ageneiosidae (AH-GENE-EE-EYE-**OH'**-SEH-DEE)
Hypophthalmidae (HY-POF-**THAL'**-MEH-DEE)
*Helogeneidae (HEL-OH-GEE-**NEE'**-EH-DEE)
Cetopsidae (SEE-**TOPS'**-SEH-DEE)
*Trichomycteridae (TRI-KO-MICK-**TER'**-EH-DEE)
*Callichythyidae (KAL-LICK-**THY'**-EH-DEE)
*Loricariidae (LOR-EH-CARE-**RYE'**-EH-DEE)
Astroblepidae (AS-TRO-**BLEP'**-EH-DEE)

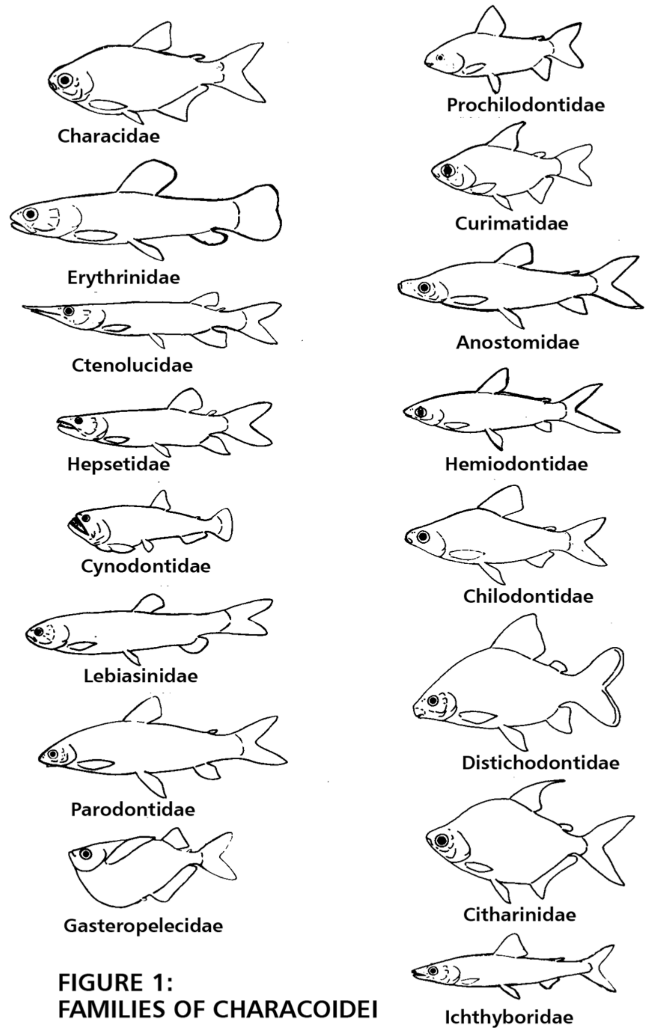

FIGURE 1:
FAMILIES OF CHARACOIDEI

(Note that Apteronotidae replaces the previously used Sternarchidae.) The important Family of Cyprinoidei is, of course, Cyprinidae that includes the barbs, minnows, rasboras, goldfish, etc. A little over 12% of our aquarium species come from this Family. Accordingly, two Families, Cyprinidae and Characidae, account for almost one-quarter of all of our aquarium species! As for the remainder of the Suborder, this includes the lesser-important Gyrinocheilidae (e.g., the Siamese algae eater, Gyrinocheilus) and Homalopteridae (which contains the strange-looking and rarely seen Gastromyzon) and the more important Cobitidae that contains the loaches and weather fishes. Catostomidae is of little interest to aquarists.

Finally, we complete our overview of the Ostariophysi with a look at the Order Siluriformes (see Table IV and Figure 3). Of the 31 Families of catfishes, 17 are considered to be aquarium Families. The catfishes supply about 13% of all aquarium species but of course we are talking about a goodly number of Families. About 37% of these catfishes come from the Families Callichthyidae and Loricariidae, however. Catfish Families of moderate importance include the Siluridae (Asian glass cats), Schilbeidae (African glass cats), Mochokidae (upside-down cats), Doradidae (talking cats), and Pimelodidae ("graceful" cats). The Malapteruridae (electric catfish) and Clariidae are of interest to catfish specialists and the others provide occasional species for the aquarium.

New Classification Of Fishes Part IV

[The Aquarium, January 1969]

The Superorder Acanthopterygii is a mammoth assemblage of some 12 Orders and 216 Families, 22 of the latter qualifying as aquarium Families. It supplies about 28% of all aquarium species. Table I indicates that one Order is of overwhelming significance, i.e. Perciformes. With regard to the others, the Gasterosteiformes contains two Families of interest (in separate Suborders)—Gasterosteidae (the sticklebacks) and Syngnathidae (the freshwater pipefishes as well as the seahorses). In Channiformes we have the snakeheads, Family Channidae (formerly Ophicephalidae); in Synbranchiformes the peculiar single-gilled eels (*Synbranchus, Monopterus*) of the Family Synbranchidae, sometimes kept by oddball specialists; in Pleuronectiformes the freshwater soles, Soleidae; in Tetraodontiformes the puffers, Tetraodontidae. These Families are pictured in Figure 1.

TABLE I

ORDERS OF ACANTHOPTERYGII

	Number of Aquarium Families
Beryciformes	0
Zeiformes	0
Lampridiformes	0
Gasterosteiformes	2
Channiformes	1
Synbranchiformes	1
Scorpaeniformes	0
Dactylopteriformes	1
Pegasiformes	0
Perciformes	16
Pleuronectiformes	1
Tetraodontiformes	1

This now brings us to the last Order, the Perciformes. With 20 Suborders, it is the largest Order of fishes. However, only 5 of its 20 Suborders contain aquarium fishes of interest, viz. Percoidei, Gobiodei, Anabantoidei, Luciocephaloidei, and Mastacembeloidei. Of the 16 aquarium Families in Perciformes, 9 are found in Percoidei, and 4 in Anabantoidei. Accordingly, we can take a quick look at the remaining 3 Families. These include Gobiidae (containing the previously-separated Eleotridae) in the Suborder Gobiodei, Luciocephalidae in the Suborder Luciocephaloidei, and Mastacembelidae in the Suborder Mastacembeloidei. In order, the aquarium fishes they represent are the gobies (e.g. *Brachygobius*), the pike head (*Luciocephalus*), and the spiny eels (*Mastacembelecus*). Except for the gobies, most are specialist's fishes. The Families represented by these fishes, and the Families in the Suborder to be discussed, are shown in Figure 2.

A survey of the Suborder Anabantoidei is shown in Table II (all Families are aquarium Families). This is rather interesting as it shows that the bubble nesters are now divided into four Families. Separated from the Anabantidae (which contains the betta and the common aquarium gouramies) are the comb tails, *Belontia* (in Belontiidae), the kissing gouramies, *Helostoma* (in Helostomatidae), and the gourami, *Osphronemus* (in Osphronemidae).

TABLE II

FAMILIES OF THE SUBORDER ANABANTOIDEI

Anabantidae	(ANA-**BAN'**-TEH-DEE)
Belontiidae	(BEL-LON-**TY'**-EH-DEE)
Helostomatidae	(HEL-LO-STOW-**MAT'**-TEH-DEE)
Osphrdnemidae	(OS-FRO-**NEE'**-MEH-DEE)

We now come to the final Suborder, Percoidei. Because it contains 71 Families, however, it is impractical to list each of them. Accordingly, we have listed only the 10 aquarium Families in Table III, with sketches of each Family being shown in Figure 3. The most significant Family is, of course, Cichlidae, which provides about 10% of the total species of aquarium fishes. Other moderately important Families include Centropomidae (which contains the previously separated

TABLE III

AQUARIUM FAMILIES OF THE SUBORDER PERCOIDEI

Typical Aquarium	Genus
Centropomidae (SEN-TRO-POE'-M EH-DEE)	Chanda
Theraponidae (THER-AH-PON'-EH-DEE)	Therapon
Kuhliidae (KU-LYE'-EH-DEE)	Nannoperca
Centrarchidae (SEN-TRARK'-KEH-DEE)	Elassoma
Monodactylidae (MONO-DAK-TY'-LEH-DEE)	Monodactylus
Toxotidae (TOX-OTE'-TEH-DEE)	Toxotes
Scatophagidae (SCAT-TOE-FAY'-GEH-DEE)	Scatophagus
Nandidae (NAN'-DEH-DEE)	Polycentrus
Cichlidae (SICK'-LEH-DEE)	Cichlasoma

TABLE IV
COMPOSITION OF AQUARIUM SPECIES

A. By General Type		B. By Families	
Characin forms	18%	Cyprinidae	12%
Carp-like forms	15%	Characidae	11%
Catfishes	13%	Cyprinodontidae	11%
Killifishes	11%	Cichlidae	10%
Cichlids	10%	Poecilidae	5%
Livebearers	6%	Anabantidae	3%
Bubblenesters	3%	Callichthyidae	2%
Total	76%	Loricariidae	2%
		Total	56%

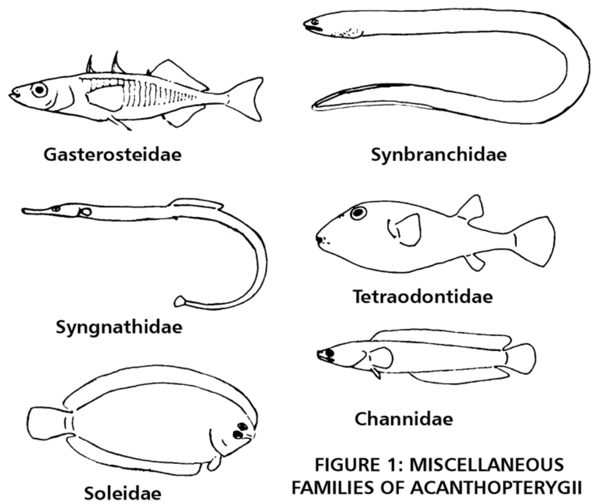

FIGURE 1: MISCELLANEOUS FAMILIES OF ACANTHOPTERYGII

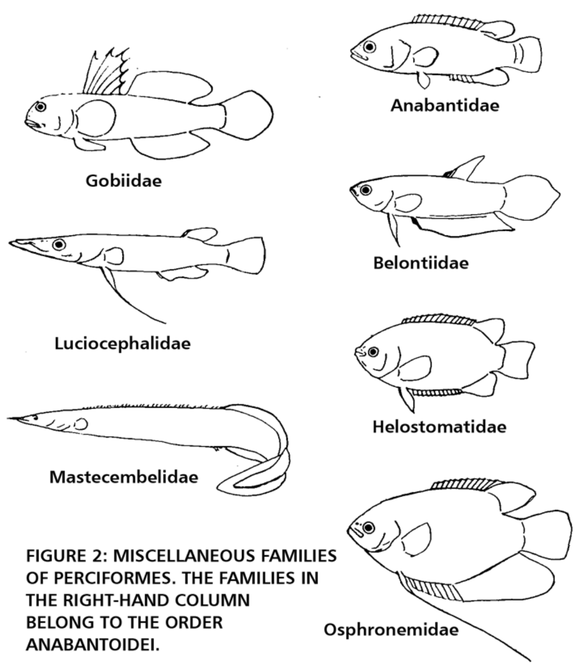

FIGURE 2: MISCELLANEOUS FAMILIES OF PERCIFORMES. THE FAMILIES IN THE RIGHT-HAND COLUMN BELONG TO THE ORDER ANABANTOIDEI.

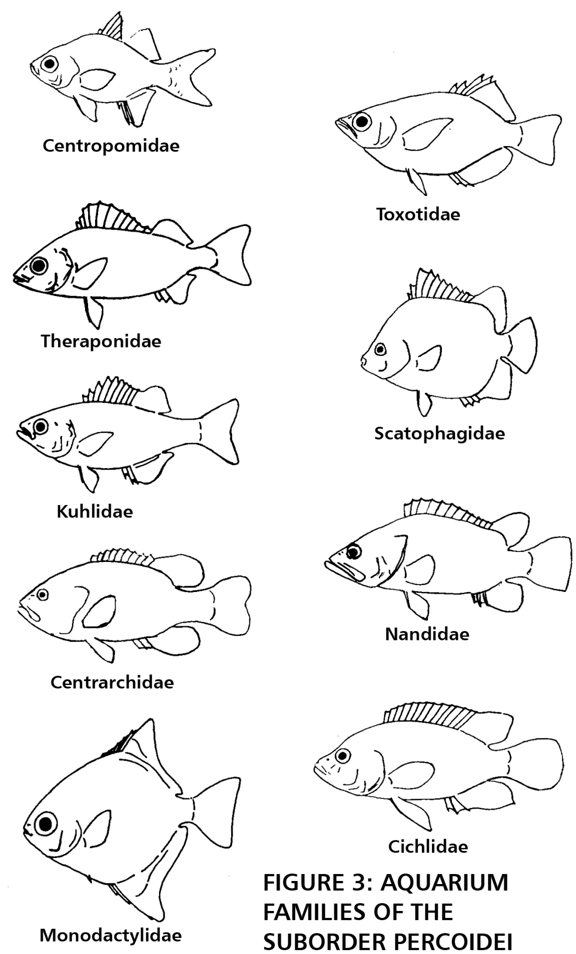

FIGURE 3: AQUARIUM FAMILIES OF THE SUBORDER PERCOIDEI

Chandidae and Ambassidae) for its glassfishes, Monodactylidae, Toxotidae (archer fishes), Scatophagidae (scats), and Nandidae (leaf fishes). The less-important Families include Theraponidae (target perches), Kuhliidae (certain cichlid-type fishes found in Australia, and Centrarchidae (pigmy sunfishes).

This, then, concludes our discussion of the classification of fishes, with particular emphasis upon freshwater aquarium Families. It has been possible, as a byproduct of this series of articles, to estimate the individual contributions to the total number of species of aquarium fishes on the basis of both major groupings and Families. These estimates are shown in Table IV. Of the 412 Families of teleostean fishes, therefore, we obtain almost half of our aquarium species from but five of them!

A Bookshelf Aquarium

[The Aquarium, October 1968]

Note: This is one of the articles I wrote under the pseudonym of Harriet Connelly.

Although my fascination with fish is great, my ardor for a labyrinth of wires and airline tubing is strictly lukewarm. Being in need of additional bookshelves, I decided to solve both problems simultaneously by combining an aquarium with a piece of functional furniture. A Chippendale I am not, so the construction to be described was accomplished with the use of hand tools plus an electric drill, the millwork (cutting) being done for me by the lumberyard from which the wood was purchased. All of the joints were of the simplest possible type, i. e., "butt joints." Screws (1+ inch) were used throughout, their heads countersunk and filled with plastic wood. After sanding, such a construction is ready for painting. Believe me, the

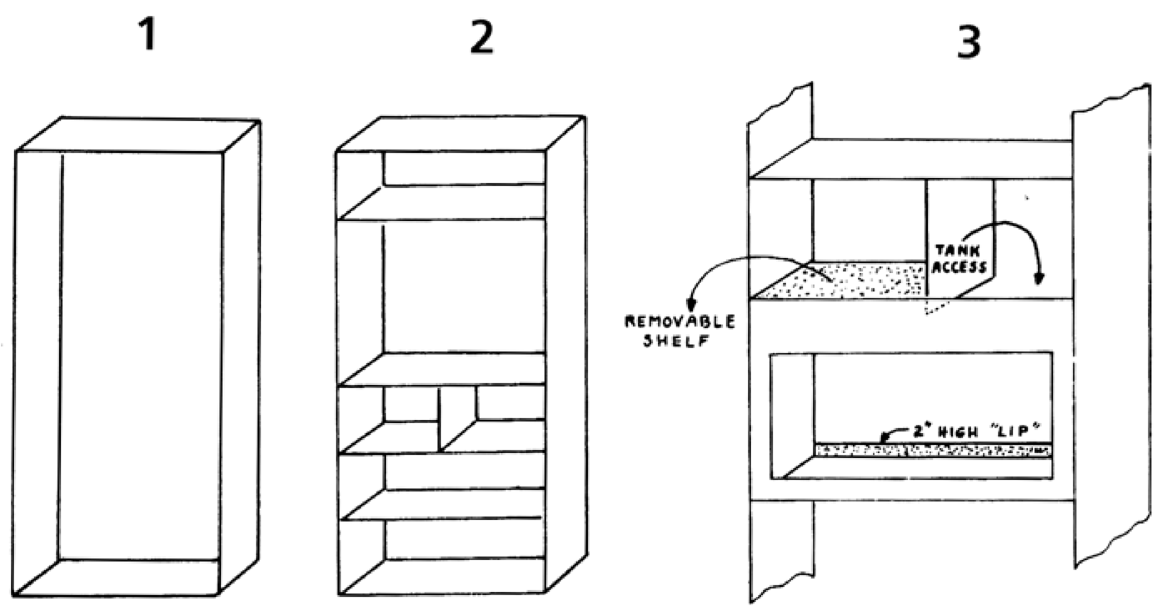

FIGURE 1: Step one: A simple box is constructed.
FIGURE 2: Step two: Four shelves and a divider piece are now added.
FIGURE 3: Detail of the tank compartment, showing tank access, the false shelf and the lip that forms the water-tight tank compartment.

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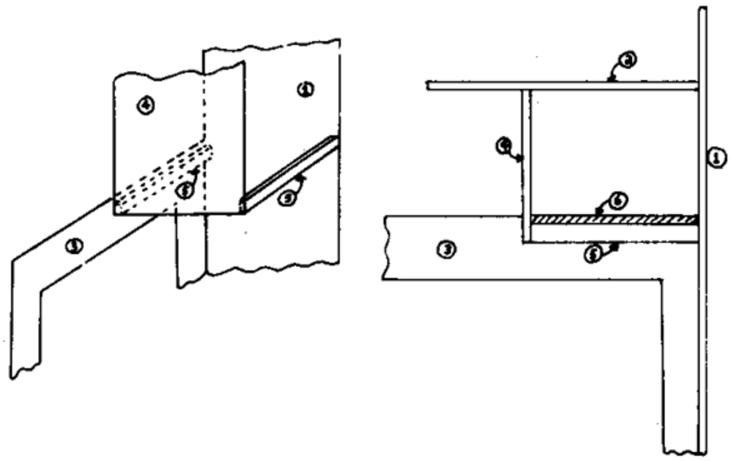

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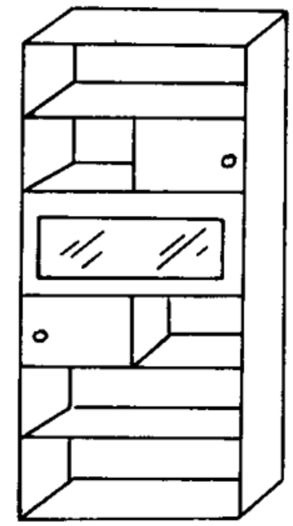


FIGURE 4: Details of the false shelf. 1-Left side piece. 2-Shelf one. 3-Front piece that frames the tank. 4-Divider piece, projecting 3 inches below the top of the front piece. 5-1" x 2" railings to support the fa/se shelf. 6-The false shelf in place.
FIGURE 5: A schematic showing the completed construction, with doors and tank in place.

liberal use of plastic wood, sandpaper and paint hides a great many of the amateur’s mistakes. Indeed, the results look quite professional!

The primary wood used was 1” x 12” hemlock (a clear pine is also excellent). Step one (see Figure 1) consisted of fastening together a box, 6i’ x 30”. Step two added five more pieces of wood (see Figure 2). Four of these were 30-inch horizontal shelves, situated at 12, 24, and 36 inches from the bottom, and 12 inches from the top. A 12” x 12” divider piece was placed in the middle between the second (counting from the top) and third shelves as shown in Figure 2.

The construction between shelves one and two was a bit more complicated. The tank (I used a 12-gallon aquarium) was to sit on shelf two, to be serviced from the top. To this end, a “false” shelf was constructed between shelves one and two, located 12 inches below shelf one. This provided about 18 inches of space between shelf two and the false shelf above (see Figure 3).

First, a front (30” x 18”) which ultimately was to frame the tank, was cut from + inch plywood and fastened in place as shown in Figure 3. Next, a divider piece was cut so that it projected 3 inches blow the top of the front piece (this is clearly shown in both Figure 3 and Figure 4). The divider piece was screwed to shelf one, and one screw entered it at the bottom through the front piece. This last screw, however, was not sufficient to hold the divider piece steady at the bottom, so a piece of 1” x 2” pine connected the divider to the side of the construction (the left side) at the back. The details are shown in Figure 4 that shows views from the back of the construction. An identical 1” x 2” piece was screwed to the front piece, 1 inch below its top. These two 1” x2” pieces formed a sort of railing with which to support a removable 12” x 15” shelf. Next, a 30 inch long 1” x2” “lip” was screwed to the bottom of shelf two (see Figure 3) and to the sidepieces.

The final step before finishing was to cut two 12” x 15” doors from 3/4 inch plywood, and to fasten them with decorator hinges as shown in

Figure 5. Screw heads, gouges, etc., were filled with plastic wood and the construction was sanded. The doors were painted a copper color; the remainder of the construction was finished in flat black. This, however, is a matter of individual taste. To form a watertight compartment, 2 inches high, shelf two and the surrounding wood to a height of 2 inches was painted with an epoxy paint. When this dried, Silastic was used on all joints as if glazing an aquarium. Although I used the reflector that came with the tank, an ordinary fluorescent fixture could be fastened to the front piece that frames the tank.

The 12-gallon aquarium was placed on shelf two, right against the frame. Although the watertight compartment would be useless in case of a massive release (such as would happen if a glass side were to break) of water, it is very effective against a slow leak. This was important to me as books are stored below and can easily be damaged by water if precautions are not taken.

Day-to-day access to the aquarium is via the upper door. There is more than enough "headroom" here for feeding, cleaning filters, adjusting thermostats, etc. On those rare occasions when it becomes necessary to gain access to the other half of the aquarium (changing bulbs, repositioning a rock, cleaning glass, etc.), the books on the false shelf are removed and the shelf lifted out by pushing up from below after reaching over from the door side. Since removing the books is a bother, I have since replaced them on the false shelf with an objet d'art that is more conveniently moved.

A photograph of the finished bookshelf aquarium.

All of the electrical equipment (pumps, switches, etc.) is concealed in the cabinet below. Further, there is room left over for storage of food, rags, charcoal, and all of the other paraphernalia characteristic of the hobby. But beyond the advantages accruable to "neatness counts," the whole effect is simply striking. In the evening, when the only light in the bookcase corner is that from the tank itself, all eyes are upon it. The combination of books and fish seems to enhance both hobbies equally well.

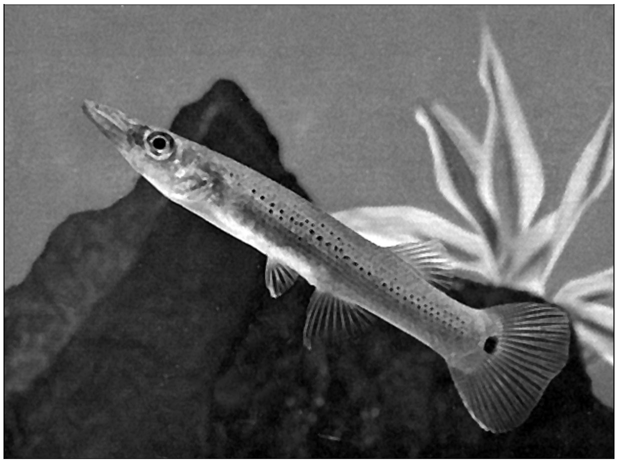
The Pike Livebearer

[The Aquarium, November 1968]

Note: This is one of the articles I wrote under the pseudonym of Harriet Connelly.

In the aquarist's catalog of livebearing fishes we find a varied collection - the peaceful as well as the predator, the tiny with the large. Among the fresh and brackish waters of the Atlantic coast of Southern Mexico, British Honduras, Honduras and Nicaragua lurks one of the aquarist's most unusual livebearing fishes, *Belonesox belizanus*, the aquatic giant of the livebearers. Its large size, bizarre appearance and ominous reputation always draws a large crowd of hobbyists when on public display.

In most cases, the wicked-looking jaws are the first part to attract attention. In many ways, the fish resembles our common pike, hence the popular name. The substantial curve to both the upper and lower jaws does not permit *Belonesox* to close them. As a result, row after row of fine teeth are easily visible, enhancing its appearance as a "mean" fish. The overall coloration is olive-green, flecked with regular rows of small black spots. In reflected light the sides show an iridescent green, and the large black area at the base of the tail is comple-



In overall appearance, the pike livebearer resembles a sort of rocket. The many rows of very fine black spots on the sides of the fish enhances its appearance.
Photo by Andy Roth.

mented by a big eye. The dorsal fin is set far back on the fish, but otherwise the fins are not outstanding. The anal fin of the male serves, as in all livebearers, as a gonopodium but in *Belonesox* it is rather large and well defined.

In their natural habitat, *Belonesox* are found in neither fast nor stagnant waters, but rather along the banks of slowly moving streams, mangrove and reedy swamps, and inlets to salty bays. In the aquarium, an addition of salt is sometimes helpful to prevent fungusing of bruises, but I do not find it necessary with my fish.) They seem to prefer dirty to clean waters, and well planted to open ones. *Belonesox* have even been found in areas completely covered with algae, and in cattle watering holes! In these ubiquitous surroundings, *Belonesox* are discovered near the water surface preying on small characin-like fishes.

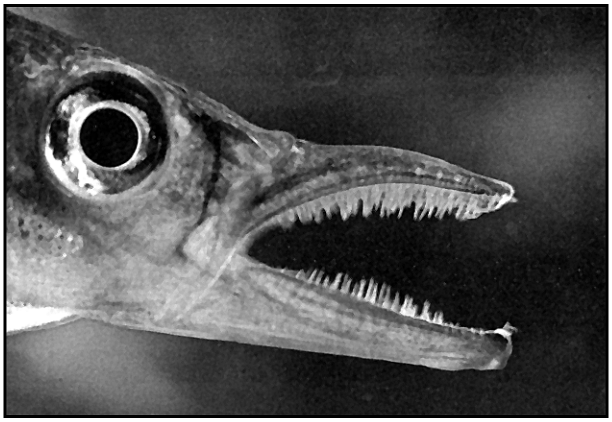
An interesting account of the collection of *Belonesox* in the wild was given several years ago by James D. Thiele of Miami, Florida. Writing in Aqua-Focus, the publication of the Aquatic Researchers of San Antonio fish club, Mr. Thiele described the experience as follows:

"On March 17, 1955, a four-man fish collecting expedition for the Navy and the University of Miami left that city by plane for Havana, Cuba, en route to Merida, the capital city of Yucatan, Mexico. The object was to collect living specimens of *Belonesox belizanus*. The fish were to be used in a research program conducted at the Department of Microbiology, University of Miami, under contract to the Office of Naval Research.

"Arriving in Merida, Yucatan at about 6 p.m. on March 17, 1955, we wasted no time in making preparations for collecting *Belonesox*. At 6 a.m. on March 18th, the four-man team started for Progresso, Yucatan, by automobile loaded with all our equipment. Our destination was a series of small rivers just outside the city limits of Progresso - information supplied to us by Dr. Luis Rivas of Miami University. Upon arrival, we observed the area and discovered a few specimens of *Belonesox*. With a large dip net, we quickly captured a nice pair which were placed in an aquarium so that our guides could be sure of what we wanted.

"They assured us they were familiar with *Belonesox* and told of a large freshwater spring (Cenote) where they were extremely large and plentiful. Our present location was almost pure salt water, so it was decided to try out the Cenote. After a lengthy trip upstream and then overland, we arrived at the site. Careful observation and search of the area turned up *Mollienesia velifera, Astyanax mexicanus, Cichlasoma meeki, C. octofasciatum, Gambusia* and *Cyprinodon*. But no *Belonesox*! We then started downstream. In a very narrow stream about two miles long we ran into many *Belonesox* but the heavy jungle growth made it very difficult to catch them. After about four hours, we managed to capture some fifty specimens. It was nearly 4 p.m. so we decided to return to the car and back to Merida.

"In the hotel, we set up plastic bags in boxes and made up an emergency aeration system connected to an oxygen tank. We decided to use this oxygen system only if an emergency arose and, if possible, to save it for the return trip back to Miami. The next day, March 19th, 1955, we collected about twenty-five more specimens of *Belonesox* and about, twenty



The "business end" of the pike livebearer. The curve of its upper jaw enhances its "mean" appearance. Once a fish is caught in this needle-work of teeth, it is held fast.

more *Mollienesia velifera*. We got in some more photography and returned to Hotel Merida about 3 p.m.

"For the rest of the afternoon, we just turned tourist and visited the interesting places in Yucatan. At 9 o'clock we came back to the hotel and were greatly alarmed. A foul odor hung about the room and almost all the fish were gasping for air. This was an emergency, so we turned on the oxygen. Within an hour, all the fish save for four *Mollienesia velifera* were in perfect condition, and so the oxygen was turned off. The next day, we packed the fish in plastic bags, filling the air space with oxygen and placing them in boxes for the return trip to Miami. On our trip back to the University, our prize *Belonesox* female gave birth to 116 young as we changed planes at Havana, Cuba. Upon arrival at Miami, we had lost only one large male and one of the newborn fry. We considered our trip very successful. Today, these *Belonesox belizanus* are playing a very important part in the research project at the University of Miami."

Perhaps the earliest of the American aquarium reports about the maintenance and reproduction of *Belonesox* was that published in the April 1930 issue of AQUATIC LIFE. The article, entitled "Notes On *Belonesox belizanus*," was written by that fish farm pioneer, William E. Schaumburg of Crescent Fish Farm in New Orleans, and is reproduced here in part:

"At the time these fish were received they were about 2-14 inches long, and careful examination convinced us that four of them were females. In this section of the country, every pool and body of water abounds in *Gambusia affinis*, so our food problem was an easy one. By December, they had grown to a big size, the males attaining a length of 4i inches while the females had reached a total length of 5 inches. We also noted that the females were gravid, so they were placed in separate tanks and fed plentifully.

"On January 12, 1930, one of them gave birth to 22 young. The female was placed back with the males two days after she had delivered her young, and on February 28th, one month and ten days after her first young were born, she gave birth to 44 young. Another female gave birth to 20 young, and the third had 18 on her first delivery. The last two have not had their second litters yet, but will in a week or ten days.

"The birth of the young was quite interesting. They were born at intervals of from 10 to 15 minutes, the first one headfirst, and the second one tail-first, and so on until the whole litter was delivered. This is nature's way of packing the young—whose forepart of the body is larger than the hind part - comfortably in the body of the female. We sacrificed one of the young immediately after birth in order to obtain accurate data on measurements, and found it to be 7/8ths of an inch long.

"Contrary to expectations, we found the female was not disposed to eat the young; in fact, we noticed that she stopped eating two days before delivery of the young. The youngsters took large daphnia and mosquito larvae the day after birth. The growth of the youngsters is undoubtedly fast. The young born on January 18th are at this writing (March 4th) two inches long. Because of the odd weather which caused a shortage of extra small *Gambusia*, they were fed on alternate days. We are going to try a later litter, when young *Gambusia* are plentiful, with a daily ration of them and see what growth is made. I predict a triple growth in 90 days.

"The fish are an interesting livebearer and will make a valuable addition to any collection, but they cannot be kept with any small fish."

My own specimens range in size from 4 to 6 inches for the females to 3 to 4 inches for the males (the largest size reported for this species is 8 inches and 5 inches for females and males respectively). At first they were kept in a 29-gallon aquarium, but needing the space I transferred them to a 10-gallon tank. During an effort to feed them earthworms, white worms, dry and frozen foods, the *Belonesox* took no nourishment for almost two weeks. At no time did they molest each other despite the disparity in sizes. Finally, it was considered advisable to resume their normal fare of adult guppies. Fortunately, my work in line breeding various strains of guppies provided me with enough culls to feed the *Belonesox*.

The temperature of the aquarium that houses my *Belonesox* fluctuates between 75 and 90°F, with no evidence of discomfort to the fish. Two of the females presented me with batches of young, enabling me to study them under aquarium conditions. The first batch was not long in being devoured by the parents, contrary to Mr. Schaumburg's experiences, but the second was saved by the concealment afforded by a handful of anacharis thrown in for just that purpose. Each batch numbered about forty 3/4-inch baby *Belonesox*. Resembling little sticks, their sides were marked with a black stripe. The dorsal and anal fins were orange-tinted, and although they lacked the huge jaws of the parents, they did have an enormous eye.

The feeding problem was easy in this case, for the young ate frozen brine shrimp and frozen daphnia from the start. German aquarists, who have known this fish since 1909, have stated that the young are compatible, but my observations indicate otherwise. I paused from a photographing session in time to see a week-old *Belonesox* grab a companion by the middle of the body. After struggling for over 20 seconds, the victim managed to free itself, minus quite a few scales.

As an experiment, I placed a young guppy two-thirds the size of the baby *Belonesox* in their tank. Within a minute, a baby *Belonesox* grabbed it about the middle, tossed it and had it swallowed. Over the succeeding weeks, however, I was able to train the *Belonesox* to eat grated, frozen beef heart. This was a great relief as I was fast running out of guppies!

Belonesox belizanus is a fascinating fish, definitely one of those "different" livebearers. As much as I do not like to inject a sour note here, it should be mentioned that the species is one of those on the restricted list in the State of Texas, and aquarists wishing to keep *Belonesox* there must obtain a permit for them and presumably for each one of the young that may come along in time. 'To further compound this nonsense, the State also requires notification in writing should the aquarist decide to get rid of his *Belonesox*. What fools some mortals be!

Because the pike livebearer is so striking in many ways, aquarists often over-look the fact that it is a livebearer, one of the hobby's largest in tact. As with all livebearers, the anal tin of the male is modified to form a gonopodium, used during the mating process.

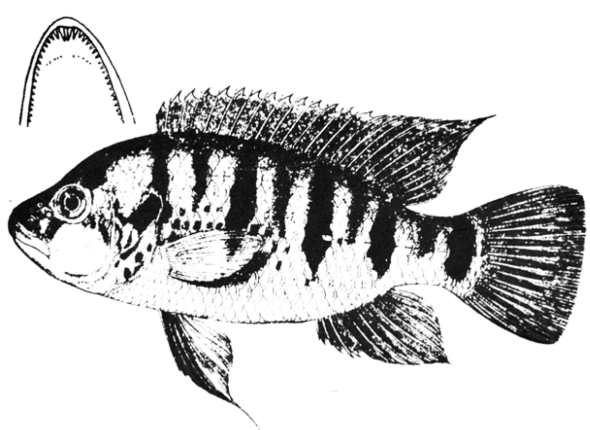
Of Cichlids and Names

[The Aquarium, March 1969]

Some time ago, the British aquarium magazine, PETFISH MONTHLY, published an article purporting to discuss the cichlid, *Pelmatochromis annectens.* There followed an exchange of letters in that publication, which appeared as follows:

"The article by Dave Lelliott ('Spawning Success With *Pelmatochromis annectens'*) appearing in the July, 1968, issue of PETFISH MONTHLY immediately caught my attention as this species has not been seen in the United States for many years. A glance at the accompanying photograph and the text, however, quickly indicated that the subject of Mr. Lelliott's article (and the photograph) was not *Pelmatochromis annectens* but rather *Hemichromis fasciatus.* The latter has been seen in this country frequently, but in very limited numbers, over the past four or five years.

***"Hemichromis fasciatus* is found over a range that extends from Senegaland Gambia, in the West African 'bulge', eastward into the basins of the Tchad, Niger and Congo rivers, and southwards to Portuguese Angola and the two (formerly) Rhodesias. As might be expected with a species with such an extensive distribution, it boasts an impressive list of synonyms including *H. auritus, H. leiguardi,* and *H. desguezi.* The fish does display a distinct resemblance to *Pelmatochromis arnoldi* (which, in turn, is frequently confused with *P. annectens)* but may be distinguished from that species by its general lack of color sexual dimorphism, by its more pointed head, by the absence of the pronounced frontal gibbosity so characteristic of the males of *P. arnoldi,* and by the absence of the cluster of metallic white scales above the vent that is especially characteristic of the females of *P. arnoldi. Albert J. Klee, Editor,* The AQUARIUM MAGAZINE."**



Hemichromis fasciatus

The author's reply was as follows:

"Secretly I had hoped for some form of correspondence, preferably constructive, regarding my article 'Spawning the *Pelmatochromis annectens'.* Consequently I was very pleased to read this letter from Mr. Albert Klee.

"For some time I have been having interesting conversations over these fish, particularly regarding their identification. The only means of identification I have are the popular books. Most of these conversations are started by some other aquarist denying these fish the name *annectens* without offering an alternative. Others offer the name *Hemichromis fasciatus.* I am not at all sure what it should be but will point out my reasons for deciding on *Pelmatochromis annectens* until something more certain becomes apparent.

1. '*annectens'* means 'link'; probably between species, possibly between genera? This fish seems to carry some of each of three different fish's characteristics, i.e., *P. annectens, P. arnoldi, and H. fasciatus.*

2. My fish spawned when 4-1/2 in. long and are now 5 in. in size. *H. fasciatus,* quoting Sterba, grows to 30 cm., *P. annectens* reputedly grows to 5 in.

***3. H. fasciatus* are supposedly good parents, as were my fish. *P. annectens,* being cichlids, are probably also good parents and rear their young.**

4. Colour. My fish do not carry the white scales above the vent as *P. annectens* do. The operculum spot on my fish is brilliant red; as stated (by Sterba) it should be in *P. annectens. H. fasciatus* carries a blue-green spot ringed with gold. The pictures of *H. fasciatus* in *Exotic Tropical Fishes* show both of the fish, male and female, carrying a large blotch on the dorsal fin; neither of my fish has this mark.

5. My fish are definitely unpleasant by temperament and greedy, eating anything that moves or has a meaty taste. This suggests that they are *H. fasciatus* or *P. arnoldi. P. annectens* is of a much milder nature.

6. All three species seem to enjoy brackish water and high temperatures and all come from about the same area.

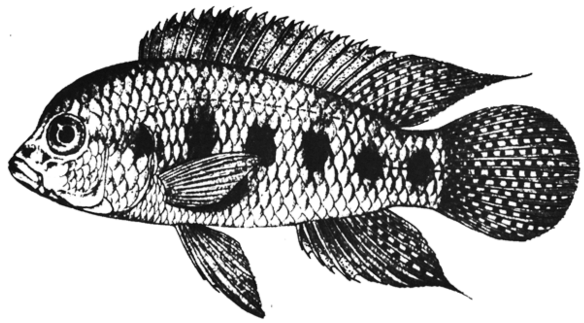
7. Finally I have shown these fish at open shows on several occasions and twice have won awards with them, once a first in class. The judges in each case have never corrected the name or approached me over them on any count, which would suggest they agree with my choice of name!

"I have named these fish *P. annectens* because of the facts I have presented in this letter and because the dealer who sold them to me named them *P. annectens.* I will therefore be very pleased to hear from anyone who can ensure their identification positively. I hope in the future to be able to approach the British Museum with some of these fish for positive identification. *Dave Lelliott."*

As can be seen, the letters did not do much in the way of settling this matter for British aquarists!

On the cover of the January 1968 issue of THE AQUARIUM, we depicted the cichlid, *Hemichromis fasciatus.* However, the source from which the fish was obtained took issue with that identification. Finally, during my attendance at the American Killifish Association

TABLE I				
COUNTS AND MEASUREMENTS				
	THE AQUARIUM cover fish	*P. arnoldi*	*P. annectens*	*H. fasciatus*
Dorsal	XIV 10	XV-XVI 10-11	XV 9-10	XIII-XV 11-13
Anal	III 9	III 8-9	III 7-8	III 8-10
Scales, long.	29-30	28	28-29	29-32
Scales, lat. line	16/11	10/8-9	18-19/9-10	15-19/10-15
Scales,tray.	24-34/94	24-3/10-11	21/10-11	3-34/10-11
Depth in length	3.1	2.5-2.7	2.6-2.75	2.25-3
Length of head 2.65	3	2.8	2.5-3	
Eye in head	4	3.5-3.7	3.5	3.5-6
Eye in interorb.	1.72	1.3-1.5	1	1.25-1.75
Scales on cheek 5	5	3-4	3-4	4-6
Pectoral in head	0.57	0.75-0.8	0.75	0.5-0.7
Snout profile	straight to	concave	convex	straight or
concave	concave			
Snout to eye	snout longer	snout = eye	snout = eye	snout longer
Teeth	2 incisor teeth in median position; minute teeth in second row, separated from outer row	teeth small, in three series	teeth in three or four series ; outer rather large	2 incisor teeth in median position; minute teeth in second row, separated from outer row



Pelmatochromis arnoldi

convention in St. Louis in September 1968 I was asked to identify a particular cichlid in the collection of a local wholesaler. As it was the same fish that appeared on the cover of THE AQUARIUM, my reply was that it was *Hemichromis fasciatus.* The dealer dissented, however, and said that the fish was *Pelmatochromis arnoldi.* He took me to another tank containing what I perceived to be the same fish and proclaimed *it* to be *Hemichromis fasciatus.* Clearly, it has not been my day!

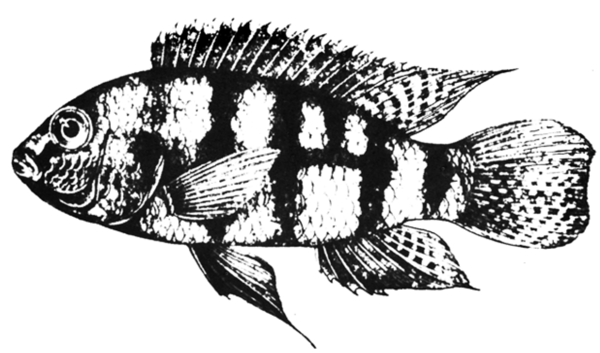
It became apparent then, that it was necessary to secure specimens and to conduct a detailed examination of both the fish in hand and the pertinent scientific literature. To this end, the cover specimen was pickled (much to the dismay of our photographer, Audrey Roth!), as was also one of the young of the *Pelmatochromis arnoldi* secured in St. Louis.

It is, however, useful to return to the seven points elucidated in Mr. Lelliott's letter, and to comment upon them one by one. Point 1 is surprisingly clever in view of the fact that Mr. Lelliott had not consulted the scientific literature in this regard. The term "annectens" does mean "link," and indeed that is how the author of the species intended it, but the linkage was within the genus *Pelmatochromis* and had nothing to do with *Hemichromis.* Concerning Point 2, Sterba does quote *H. fasciatus* as reaching 30 cm. (about 12 inches) but this is close to maximum; aquarium specimens are usually much smaller and *H. fasciatus will* spawn at four or five inches. Point 3 is not helpful in this matter; the same statement is made of two species.

Point 4 contains an argument in favor of *H. fasciatus* (absence of white scales above the vent), and one against (red opercular spot versus the blue-green spot mentioned by Sterba). The color of a spot, however, frequently has little or nothing to do with the identification of a fish. As I pointed out in my letter, *H. fasciatus is* extremely variable (note the synonyms for it); some specimens have red opercular spots, others have blue-green spots. As for the picture of *Hemichromis fasciatus* in *Exotic Tropical Fishes, I* can well understand Mr. Lelliott's dilemma - the fish pictured is a *Tilapia,* not a *Hemichromis!*

Point 5 is an argument against *P. arnoldi,* and Point 6, like Point 3, contributes no information whatsoever. Point 7 illustrates precisely the problems in amateur fish identification today. Mr. Lelliott maintains that since on several occasions judges did not correct his name, he must be right. Heaven save us from this sort of logic!

A detailed examination was made of the cover fish (shown in the accompanying photograph), identical with Mr. Lelliott's fish. The results are shown in Table I where they are compared with *P. annectens, P. arnoldi,* and *H. fascia-*



Pelmatochromis annectens

tus. The fish is clearly *Hemichromis fasciatus.* It is remarkable how closely *H. fasciatus* and *P. annectens* resemble each other in certain basic counts, and in appearance. However, the aquarist can easily tell them apart by the longer snout and straight-to-concave head of the former (see the accompanying diagrams of the three species).

To an ichthyologist, of course, the teeth are the important things. Indeed, it is in the matter of dentition that we primarily differentiate the genus *Hemichromis* from the genus *Pelmatochromis.* Most species of *Pelmatochromis* have two to four series of teeth in each jaw; *Hemichromis* generally have one to two. However, the two median (middle) teeth in *Hemichromis* are enlarged (see diagram), both looking like incisors. Another important difference is the presence of a nipple-like pad in front of the gill arches in *Pelmatochromis. Hemichromis* does not have such a pad (nor did the specimen I examined). Obviously, these are matters with which the average aquarist cannot cope. What is needed is specialized equipment for such examinations, and access to the proper scientific literature.

The fish I secured from St. Louis was very young and no detailed examination was made. However, the teeth structure clearly confirmed it as *Hemichromis fasciatus.* In conclusion, THE AQUARIUM cover fish and Mr. Lelliott's fish are correctly identified as *Hemichromis fasciatus.* Although identification from photographs is sometimes a risky business, the fish illustrated in *Exotic Aquarium Fishes* as *Hemichromis fasciatus* appears to be a *Tilapia* species. It certainly is not *Hemichromisfasciatus!*

The Identity Of The Rainbow Cichlid - An Anatomy Of A Fish Identification

[The Aquarium, October 1969]

Several years ago, Mr. Ken Prosser of the Elgin Aquarium Society, Illinois, brought to my attention a problem in the identification of a new fish referred to in his locality as the "red-eye" or "red-eyed" cichlid. I had already obtained several juvenile specimens from my friend Tony Volvo of Buffalo, New York, but these were without any popular name in that city at the time. Additional specimens were secured from Ken and a comparison showed the two sources to represent the same species. However, I had no idea what its scientific name might be except that it most likely was a species of *Cichlasoma*.

Recently, a fish referred to as the "rainbow" cichlid has received fairly wide distribution throughout the western portions of this country, and it has been suggested that its scientific name might be *Cichlasoma crassa* or perhaps *Cichlasoma multispinosum*. Pictures of the rainbow clearly indicated that it was identical with my earlier acquaintance, the red-eyed cichlid. As readers may be interested in the identification process, the procedure is reported, step-by-step, in the form of the following narrative.

A starting point is to pickle a number of specimens (I use a 10% formalin solution) and then

A pair of rainbow cichlids, *Herotilapia multispinosa*.

TABLE I COUNTS AND MEASUREMENTS RAINBOW CICHLID Total length 49 mm, standard length 38 mm All measurements expressed as hundredths of standard length	
1. Depth	474
2. Length of head	342
3. Diameter of eye	79
4. Length of snout	92
5. Length of caudal peduncle	53
6. Least depth of caudal peduncle	112
7. Interorbital distance	92
8. Predorsal length	316
9. Dorsal	XVIII-9
10. Anal	XI-7
11. Pectorals	13
12. Ventrals	1-5
13. Caudal	16 plus short spine above and below
14. Scales	4-27-12
15. Teeth	tricuspid

examine them under a microscope. My microscope is a binocular type, especially suited for the macro-examination of small fishes. The purpose here is to make certain key measurements (e.g., snout length, eye diameter, total length, etc.) and counts (e.g., number of dorsal spines and rays, number of scales in a lateral series, etc.). The results of such an examination on one such fish' (others were examined also) is shown in Table I.

Counts and measurements are not hard to do. The basic measurement is the "standard length," which is merely the total length less the tail. It is customary nowadays to express measurements as a kind of fraction of the standard length, i.e., "hundredths of standard length." For example, the "474" after the "Depth" entry in Table I, signifies that the "height" of the fish is 47.4% of its standard length (Note: What we would call "height", i. e., maximum distance from top of fish to its belly, ichthyologists call "depth"). Entries numbers 9 through 14 are counts, and several of them are expressed in the form of a code. The "XVIII-9" after "Dorsal," for example, signifies that the fish has 18 spines (hard, pointed structures) and 9 rays (soft, branched structures) in that fin.

The ichthyologists of years ago, however, did not express all of their measurements as we do today. Instead of reporting depth as "474", for instance, they would have recorded it as "2.1". There is really no basic difference between these two numbers as the latter is, except for a decimal point, merely the reciprocal of the former. The "2.1" reflects the fact that the depth figure goes into the standard length figure 2.1 times. There were other differences also. Snout

TABLE II A COMPARISON STUDY - Number 1			
	Rainbow	*H. multispinosa*	*C. Coryphaenoides*
Dorsal	XVIII-9	XVIII to XIX-8 to 9	XVI-12 to 13
Anal	XI-7	X to XII-7	VI to VII-9
Scales	4-29-11	4 to 6-29-11 to 12	5-31-12
Head	342	333 to 370	333
Depth	474	461 to 525	333
Teeth	tricuspid	tricuspid	conical

length was frequently related, not to standard length, but to head length. However, no matter what scheme is used, all can be converted to the modern format used in Table I.

My next step was to try to link the counts and measurements shown in Table I with a scientific name. As the fish clearly (to me, at least!) was either in the *Cichlasoma* or a related genus, I resolved to consider these only. Normally, if the locality (i.e., the place in which the fish was originally caught) were known, one would consult a reference work dealing with the fishes of that particular region. However, in this case its locality was not known and I was forced to examine a more general reference involving a much larger area and, unfortunately, many more species.

Because it was convenient and because I suspected that the rainbow cichlid was a Central American species, I selected Jordan & Evermann's *The Fishes of North and Middle America* as a starting point. This is a very old reference work and the bulk of its species that are applicable are listed under two genera: *Cichlasoma* and *Heros*. The latter is currently not used as a generic name, and its species now are generally considered under *Cichlasoma*. My strategy was to first examine the descriptions of these two genera and, if none resembled the rainbow cichlid, I would then check every species of *Cichlasoma* described after the Jordan & Evermann book was published, plus the related genera, *Petenia* and *Neetroplus*.

As it turned out, however, the job was greatly simplified. The rainbow cichlid is somewhat unique in that it has a very long anal fin. Even if it doesn't look long to aquarists, it does have a very large number of spines, i.e., 11. Of the 25 species of Heros listed in the Jordan & Evermann book, none have more than 9 anal spines. Of the 25 species of Cichlasoma, only 3 have the required number, i.e., *nigrofasciatus, multispinosum*, and *centrarchus*. However, *centrarchus* has 9 soft rays in its anal fin whereas the rainbow cichlid has 7. As *nigrofasciatus* is well known (as the "convict" or "zebra" cichlid) and obviously is not the rainbow, the field narrowed down to *Cichlasoma multispinosum*.

The next step was to carefully compare the key counts and measurements of *C. multispinosum* with those of the rainbow cichlid. Such a comparison is shown in Table II and, as can be seen, an almost perfect "fit" is obtained (readers may ignore the entry under *Cichlasoma coryphaenoides* for the moment).

Of interest now was the locality of the fish, the author of the species, and other supplementary information. The original description of the fish appeared in Albert Guenther's *An account of the Fishes of the States of Central America*,

TABLE III
COUNTS AND MEASUREMENTS
Goldstein/Beldt's Fish

1. Depth	**405 to 446**
2. Length of head	**278 to 327**
3. Diameter of eye	**89 to 92**
4. Length of snout	**51 to 67**
5. Length of caudal peduncle	**70 to 80**
6. Least depth of caudal peduncle	**124 to 132**
7. Interorbital distance	**114 to 128**
8. Predorsal length	**227 to 342**
9. Dorsal	**XVI-9 to 10**
10. Anal	**XI-8 to 9**
11. Pectorals	**13**
12. Ventrals	**1-5**
13. Caudal	**16 plus short spine above and below**
14. Scales	**4-27 to 28-11 to 12**
15. Teeth	**conical**

published in 1869 in the TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON. Upon consulting this rather dusty old reference I found that the fish was originally named "*Heros multispinosus*," and that it was first discovered in Lake Managua, Nicaragua. Guenther gives as its dorsal, anal and scale counts, XVIII-9, XI-7 and 4-29-12, respectively. This agrees very nicely with our pickled specimen of the rainbow cichlid. Further, not only does Guenther's written description agree with the rainbow cichlid, but also the drawing provided by him is the proverbial" dead ringer" for the fish.

There remained, however, a few more details. In 1896, Guenther placed his fish in a new genus, resulting in the name *Herotilapia multispinosa*. In 1966, Dr. Robert R. Miller (in "Geographical Distribution of Central American Freshwater Fishes", COPEIA, No. 4, pp. 773-802) confirmed that *Herotilapia multispinosa* is still considered the correct name for this species, not "*Cichlasoma multispinosum*." After additional checking of some other ichthyological references, it was also learned that the range of the rainbow cichlid must be extended to include the Atlantic coast of Costa Rica as well.

The only loose thread that remained was to dispose of the name "*Cichlasoma crassa*." As it turned out, this name is a synonym for the chocolate cichlid, *Cichlasoma coryphaenoides*, a Brazilian fish of long aquarium standing. The counts and measurements for *C. coryphaenoides*, shown in Table II, clearly demonstrate that it cannot be the rainbow cichlid. Thus, the task was completed and another aquarium "mystery" solved. At least, that's what I thought!

Enter upon the scene at this point Dr. Robert Goldstein, a long-time friend of the author, cichlidophile, and very active member of the American Cichlid Association. Knowing of my investigations, he informed me that he had received an entirely different fish under the assurance that it was *Herotilapia multispinosa*. While we were both visiting Beldt's Aquarium in St. Louis during the recent American Killifish Association (Dr. Goldstein is also an avid killifish fancier), we had an opportunity to compare the rainbow cichlid and this new fish. The "*Herotilapia*" essentially was a silver-and-black fish but whose markings resembled those of the rainbow cichlid quite closely (see photograph).

Dr. Goldstein kindly sent me two preserved specimens of "*Herotilapia*" and I promptly made the necessary counts and measurements noted in Table III. The fish keyed out very nicely with *Cichlasoma centrarchus* (as shown in Table IV), a species from Lake Nicaragua. As the determining factor of the genus Herotilapia is the presence of tricuspid teeth, the matter was quite settled now. Finally!

TABLE IV

A COMPARISON STUDY—Number 2

	Goldstein/Beldt's	*C. centrarchus*
Dorsal	XVI-9 to 10	XV to XVI-8 to 9
Anal	XI-8 to 9	X to XI-7 to 9
Scales	4-27 to 28-11 to 12 6-28-11	
Head	278 to 327	357 to 385
Depth	405 to 446	475 to 525
Teeth	conical	conical

Summary:

1. The rainbow cichlid is *Herotilapia multispinosa*, a fish native to Nicaragua and Costa Rica. The genus is characterized by the presence of tricuspid teeth and contains but one species (at this writing).
2. The black-and-silver fish currently masquerading as "*Herotilapia multispinosa*" is, in reality, *Cichlasoma centrarchus*, another Nicaraguan fish (whose range may also include Costa Rica).
3. The appearance in the aquarium hobby of two cichlid species at about the same time which very closely resemble each other morphologically, and possessing a rather unique feature (a high anal fin count, shared in the hobby only by the zebra or "congo" cichlid), is highly unusual, to say the least!

The Fish From Lemon Lake

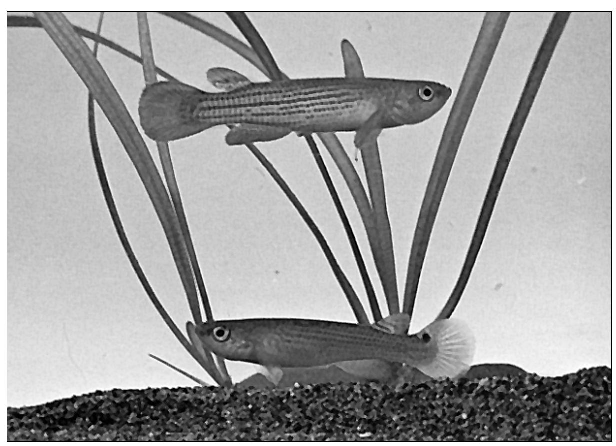
[The Aquarium, June 1970. Note: This article was co-authored with E. Roloff, AJK being the Senior Author.]

To some readers, it might seem surprising that the authors have not yet met personally (being separated by some 6700 miles, "as the crow flies"), and stranger still that our personal involvements with the subject of our article are separated in time by a span of precisely seven years. What we do share, however, are explorations of a country hitherto not brought to the attention of the aquarium hobby - Ecuador. Although we traveled to a limited extent the same route, not all was duplicated by any means. As a consequence, we are able to provide a rather unique written record, both popular and scientific, of a new aquarium fish, *Rivulus limoncochae*.

Our introduction to the tiny (area 104,506 square miles, population 5,500,000) country of Ecuador was via Quito, its capital, nestled in the north central Ecuadorian Andes at an altitude of 9,350 feet, where the nighttime temperature is decidedly hostile even to Ecuadorian tropical fishes. To the west and the east (Occidente and Oriente, respectively) lie tropical jungles. The Oriente, however, holds a certain fascination for all travelers. Home of two rather fierce Indian tribes, the Aucas and the Jivaros, the area today is still virtually unexplored. Certainly this is true with regard to its fishes.

In June 1961, Mr. Roloff commenced his expedition to the Oriente, through the kind assistance of the Wycliff Bible Translation Mission, with a flight via a single-engine Cessna aircraft from Quito to the missionary station of Limoncocha that lies on the Rio Napo, not very far from the Peruvian Amazon (see map). The Limoncocha missionaries (American and Canadian) rendered all possible assistance, and even provided quarters in the form of a guesthouse. We have found this kind of hospitality typical in such remote areas of South America, where the jungle is notably inhospitable to man.

The word "cocha" is Indian for lake; hence the name "Limoncocha" means "Lemon Lake." In 1959, five missionaries from this station were massacred by the Auca Indians; even at this writing this tribe is considered extremely dangerous.



A pair of *Rivulus limoncochae*, male above, female below. This is the first Ecuadorian killifish to be introduced to the aquarium hobby. Photo by E. Roloff.

Next to the largest mission building, in which communal meals were taken, there flowed a small brook or rivulet that emptied into a large lagoon, the Limoncocha. The lagoon was home to piranhas, other large fishes, and small tetras in abundance. Unfortunately, the last had little in the way of color that would kindle the interest of the average hobbyist.

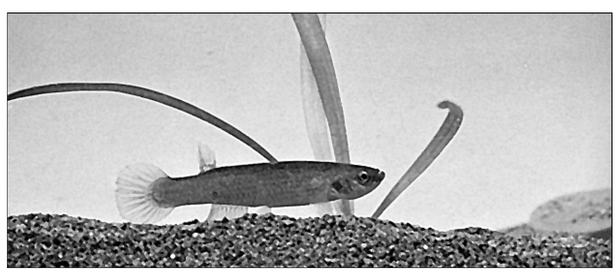
The brook, on the other hand, was quite a different matter. It was here that Mr. Roloff discovered his new *Rivulus* species. This brook was about a yard wide. With each rainfall its depth increased, sinking within a few hours to only 10 or 12 inches. The water hardness was about 17 ppm, the temperature (at midday) approximately 79 degrees F. Because of the surrounding jungle vegetation, the water was deeply shaded. The *Rivulus* were found mainly beneath tree roots, and under twigs and leaves that had fallen into the water. Although they were easy to catch, the fish also jumped with ease from the nets!

A second kind of *Rivulus* was found in this stream. Unfortunately, even after much effort, only a single male specimen was captured. It sported an intense reddish coloration when first netted, which later faded in the aquarium. Back in Germany the fish was preserved and sent to J. J. Hoedeman of the Amsterdam Zoological Museum for identification. This single specimen keyed-out to *Rivulus urophthalmus* (see reference), a species previously known to occur in the lower Amazon and the Guiana lowlands. It represents, therefore, the most western example of the species, and most likely the one from the highest altitude.

Mr. Roloff also sent Hoedeman 25 specimens of the first *Rivulus*. As Hoedeman records: **"The single specimen made me decide to describe the other 25 specimens from the same habitat as a new species"** For those readers of a scientific bent, this is an interesting situation. The new *Rivulus* was clearly a member of the *urophthalmus* complex of *Rivulus* species and, if the solitary specimen of *urophthalmus* had not been collected from the same stream, the scientific conclusion might well have been that the new fish was merely a subspecies of *urophthalmus* (or another species in the complex). Such was not the case, however, and Hoedeman described the fish as a new species, *Rivulus limoncochae*. (In general, the new species has a lower scale count and higher fin counts than *urophthalmus*.)

Rivulus limoncochae (and the solitary male *urophthalmus* collected by Mr. Roloff) is shown in the accompanying illustrations that document its colors and patterns very nicely. The species reaches a length of 2 inches, and is easily kept and bred in the aquarium. Its eggs (which average 1.8 mm in diameter, compared to 1.5 mm for *Rivulus urophthalmus* are typically deposited in the aquarium among fine-leaved plants or nylon spawning mops. They hatch after two weeks at normal killifish holding temperatures. The young pose no problems and are easily reared on newly hatched brine shrimp.

The species is not what one would consider a dedicated surface fish, as it prefers the middle stratum of the aquarium. It is somewhat livelier than the typical *Rivulus* species (including the solitary male *R. urophthalmus* specimen



The single male *Rivulus urophthalmus* caught by E. Roloff in the same rivulet in which he found *Rivulus limoncochae*. The position at the bottom of the tank was typical for this particular specimen. Photo by E. Roloff.

collected at Limoncocha which exhibited little movement in the aquarium and which was usually to be found situated at the bottom, concealed between stems of Vallisneria).

In June of 1968, an expedition led by Mr. Klee explored various parts of Ecuador for tropical fishes. This included the Oriente, but much farther south than the site visited by Mr. Roloff. A base camp was established at the Catholic Mission near the Yaupi River at the Peruvian border area. Access to this area is by air only and as before, a single-engine Cessna was used to gain entrance to the region. Shortwave radio maintained contact with "civilization" at the starting point, Puyo, a town at the edge of the Oriente. The Yaupi area is home to the Jivaro tribe, famous for their shrunken heads or tzantzas. However, the Mission exerted a pacifying influence on the local Indians, so no problems were encountered in this regard. The Fathers of the Mission were extremely helpful in providing food, lodging, and guides as well.

A large lagoon near the Mission produced piranhas, *Monopterus* eels, *Aequidens* and *Crenicichla* species, silvery but nondescript tetras, and also caimans (the South American equivalent to the crocodile). On the road to the grass airstrip (the Mission was located some 45 minutes, by foot, away from the strip), a small stream or rivulet about four to five feet at its widest was probed. Due to the shallowness of the water (the depth averaged less than a foot), only hand-nets could be used. Although sunlight did penetrate to the stream at places, much of the water was shaded by the surrounding vegetation. The banks were slightly undercut and, with the natural debris that accumulated there, provided a refuge for small fishes and at the same time worked a hardship on the nets.

Nonetheless, a collection of 50 or so specimens of a small *Rivulus* was made. Preserved specimens were later compared with Hoedeman's description and identified as *Rivulus limoncochae*. These were the only fishes observed in this particular brook. The collection extends, of course, the natural range of this species by some 200 miles. Table I summarizes the water analysis made on the spot by Mr. Klee at the time of collection.

TABLE I
WATER ANALYSIS,
***Rivulus limoncochae* HABITAT**

Place: Yaupi, Ecuador	
Date: June 20, 1968	
Time: 10:45 AM	
Water temperature (mid-depth):	**72 degrees F**
pH:	**7.1**
Hardness:	**70 ppm**
Alkalinity:	**30 ppm**
Iron:	**1 ppm**
Chloride:	**9 ppm**

Mr. Klee's fish were carried in a 2-quart plastic refrigerator container (wide-mouth) in a war-surplus canvas gasmask bag slung from his shoulder, from Yaupi to Puyo via air (100 miles), from Puyo to Ambato to Santo Domingo via bus (200 miles), from Santo Domingo to Quito via private automobile (60 miles), and from Quito to Miami to Cincinnati, Ohio (4,000 miles), with no losses! While in Ecuador, the water in their container was aerated daily by scooping up a handful of water, and letting it drop back into the container from a height of about 6 inches. While in Quito, the fish were subjected to two overnight lows of 60 degrees F with no ill effects. Further evidence for the hardiness of *Rivulus limoncochae* is given by Mr. Roloff's experience. Approximately four weeks after he returned to Germany from Ecuador, he found a half-grown fish in the 3'h gallon plastic container in which the fish were originally transported. The container was tightly sealed but empty of water. Yet, the fish was alive and later developed into a strong and healthy specimen, as large as any of its brothers or sisters!

REFERENCE

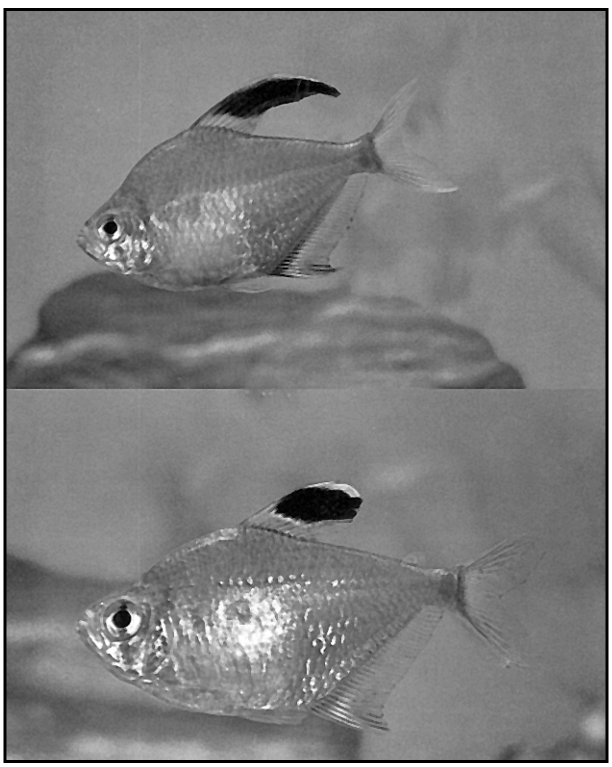
Hoedeman, J. J., "A new species of the genus *Rivulus* from Ecuador with additional records of *Rivulus* from the Upper Amazon and Ucayali Rivers," BEAUFORTIA, Vol. 9, No. 103 (August 20, 1962), pp. 145-150.

The Bleeding Heart Tetra

[The Aquarium, August 1970]

My first inkling that such a fish as the bleeding heart tetra existed came as a result of an article in the German aquarium magazine, DATZ, of December 1956. The description of the fish, which almost made my mouth water, went as follows:

"Characteristic of this fish is a bluish-red spot lying each side of the body directly underneath the beginning of the dorsal fin and surrounded by a mother-of-pearl halo. Through the eye, a black band is struck, the width of which is equal to the pupil. The dorsal fin is decorated with a red-white-black-red-white stripe. In appearance, the fish is similar to the species, *Hyphessobrycon rosaceus*."



The Bleeding Heart Tetra,
Male above, Female below.

About a year later, I felt that this description was justified when I received several specimens of this magnificent fish for my collection. At first the fish was called the "Perez tetra" and later, the "bleeding heart tetra." The former name was after the Perez Brothers of Florida, then importers and wholesalers of tropical fishes.

The bleeding heart tetra appears to be closely related to the several other species of *Hyphessobrycon.* These are as follows:

1. ***H. callistus***
2. ***H. serpae***
3. ***H. bentosi***
4. ***H. copelandi***
5. ***H. rosaceus*.**

To somewhat confuse things, the first fish, *H. callistus*, is known as *H. serpae* in this country. It is simply often called the serpae tetra. The last fish on the list is our common rosy tetra. The others on the list have been imported but usually wind up being called a serpae tetra or more often they are mistaken for rosaceus. I have seen all these species imported alive into the United States. Of them all, *callistus, bentosi, rosaceus*, and the present subject are the most colorful.

The bleeding heart tetra resembles, to a great extent, the members of the above group. Hoedeman, of the Zoological Museum of Amsterdam, named the fish, *Hyphessobrycon rubrostigma* (*rubrostigma* means "with red spot") and noted that it is probably related to the five tetras noted above. Later, Hoedeman, a Dutch aquarist-ichthyologist, saw fit to place all of these species except this one as subspecies of one species, *H. callistus*. Several other ichthyologists who have studied characins believe that they are all distinct species. It is our policy to follow the later view.

Leaving the problem of classification to the ichthyologists, the fish itself and its requirements prove somewhat less complicated. Although the exact location of its original habitat has remained a secret, we do know that the fish comes from Colombia. Full-grown adults sometimes exceed 21h inches and, at this size, the dorsal fin of the male is truly outstanding.

They are lively, schooling fish and are friendly in a community aquarium. Feeding bleeding hearts proved no problem as they fell all over one another to eat both live and dry foods. Although the water in the Cincinnati area is both hard (200 ppm.) and alkaline (7.2-7.6 pH), these fish appeared in bright colors at all times. However, when placed in an aquarium in which the water had been adjusted for delicate killifish (pH 6.0, hardness 80 ppm.), their colors became even more intense.

The bleeding heart tetra is not easy to sex since they are relatively deep-bodied fishes and the usual method of choosing the deeper-bodied fish as the female may be misleading. When less than full grown, there is no discernible difference in fin sizes either. However, utilizing an old method called, "candling," sometimes a decided difference can be seen between the sexes. Candling consists of backlighting the fish with a bright light, at which time the abdominal cavity becomes illuminated. In the females, the swim bladder is slightly curved to hook-shaped. The swim bladder in the males, on the other hand, is straighter with hardly any hook at all. These differences become more noticeable as the female fills with eggs.

A typical spawning should consist of a pair being placed in a 15-gallon aquarium (temperature 70° F, pH 6.8, hardness 80 ppm.) the bottom of which had previously been covered with *Ceratophyllum, Ambulia* or nylon yarn. The breeding play should commence shortly afterward and consist of lively dashes from one end of the tank to another. The lighting should be arranged so that the main body of the water would be illuminated but the bottom remains darkened.

Spawning usually takes place the following morning (or else be completed by then; it is sometimes difficult to state exactly when it takes place). At this time the breeders should be removed. On the second to third day after the breeders are taken away, the fry hatch from the eggs and will be observed to be free swimming in a matter of hours. The fry start immediately on newly hatched brine shrimp. One breeder I know even uses microworms. The young fry grow quite fast and are soon eating dry foods and larger brine shrimp.

I should mention here that these fishes have the same pleasing habits of display that is so well known in *rosaceus*. They pair off, male to male, male to female or female to female, extend their fins to the fullest, assume their most intense colors and literally strut in front of each other, a gorgeous sight. By the way they are peaceful like *rosaceus*, not nippy like *callistus*.

With its great beauty and easy facility for getting along with its companions, the bleeding heart tetra would disappoint no aquarist who undertakes its care.

Beginner's Corner - Aquarium Leaks

[The Aquarium, August 1970]

Note: This is one of the articles I wrote under the pseudonym of Harriet Connelly.

One common area of discouragement to the beginning aquarist is the leaking aquarium. Not only is unconfined water a darned nuisance, but also en route to "seeking its own level" it may cause considerable damage to furniture, carpets, and any other items whose appearance or serviceability is impaired once wetted.

The bond that provides for the creation of a leak-proof aquarium is formed by a combination of aquarium cement, metal, and glass. Here the aquarium cement, usually an asphaltum compound (there are aquaria available that utilize a silicone-based seal; these are comparatively expensive), bears a heavy responsibility, for if it should pull away from either the glass or the metal, a leak results. Unfortunately, many hobbyists create circumstances that lead to this condition.

For example, leaks may be cause by:

a) Lifting an aquarium while it is full of water;
b) Pressing too hard on the outside of the aquarium glass while the aquarium is empty (common during cleaning operations);
c) Maintaining an aquarium on an uneven surface;
d) Allowing the cement to dry out during storage of an aquarium.

On the other hand, the aquarist can prevent leaks from these causes by following a few simple rules:
a) Never lift a completely filled aquarium. It is much safer to empty it, or at least drain all but a few inches of water (so that you do not have to replant), before attempting the move.
b) Exercise great care when cleaning an empty tank. If possible, clean the outside glass with the aquarium filled with water.
c) Always provide a level surface to support your tanks. If in doubt about the level of any surface, a piece of ‘h or 3/4 inch plywood can be cut to fit, and placed under the aquarium to provide an even support.
d) When storing aquaria, keep some water in them, and use a tight-fitting cover (kitchen plastic wrap is fine). The moisture thus formed will prevent the aquarium cement from drying out.
e) Pretest all aquaria in an area that cannot be damaged by water seepage, by filling them completely with water. New tanks sometimes leak when first set up, and this procedure may prevent unpleasant surprises.

Once a leak has occurred while an aquarium is in service, all is not lost. Many leaks stop of their own accord once the cement has absorbed a little water. Quite often the pressure of water against the glass will effectively seal the aquarium. If a receptacle can be placed under the drip to prevent any water damage, then the aquarist might wait a few days before taking any further action. A small amount of fine earth added to the aquarium water may help end the flow by clogging the leak at its source. Unfortunately, most of it will settle to the bottom of the tank where it is unsightly. Filtration and some siphoning will remove most of this excess. I have had many successes with this method, and some failures that were “beauts”!

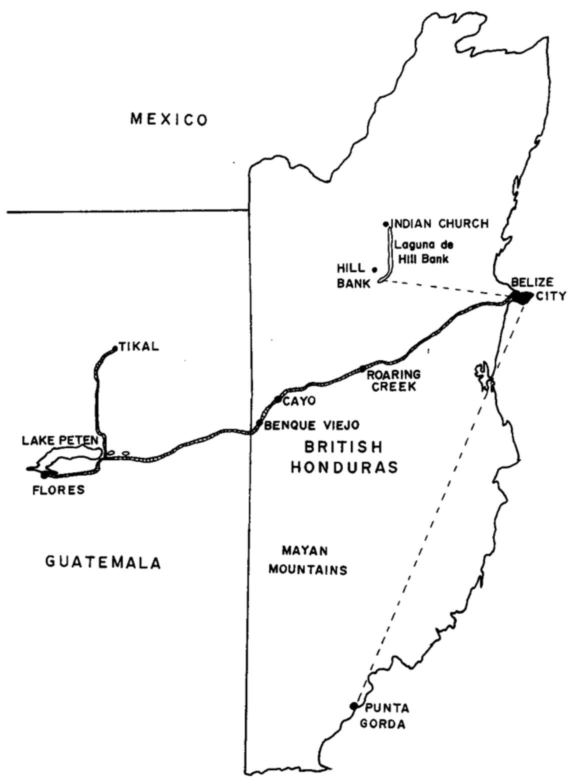
If the leak does not cure itself, then the tank must be emptied and repaired from the inside. Exterior methods are usually worthless. (I have tried repairing some leaks from the outside, using silicone-based sealers, with some success. A quick wipe with a dry towel to momentarily obtain a fairly dry surface, then a fast application of the sealer is the technique I used. The finished product is not a thing of beauty, however!) Make sure that the tank is completely dry and clean of any grease, dirt, and sand particles. Apply a coat of silicone aquarium cement on all inside joints, and allow to dry. Unlike asphaltum compounds, silicone aquarium cements resist drying and shrinking. They bond better to metal, glass, and slate, and even with age they maintain a good deal of their original flexibility.

In Quest of the Mayans – Part I

[The Aquarium, December 1970]

I am writing this chronicle from my cot in a modest pension in Charlotte Amalie, St. Thomas, the U.S. Virgin Islands. The rain, which started almost immediately after my colleagues and I (on business for the U.S. Public Health Service for the next twelve days) landed at Truman Airport which serves this small island, has restricted us to our rooms, narrow boxes in a building that seems ready to fall apart should the rain increase its beat upon the roof but a bit more. However, this story is not about the Virgin Islands (there are no freshwater fishes here anyway!). Rather, it is about the land of Mayans and cichlids, of dusty roads and mollies, of jungles and swordtails.

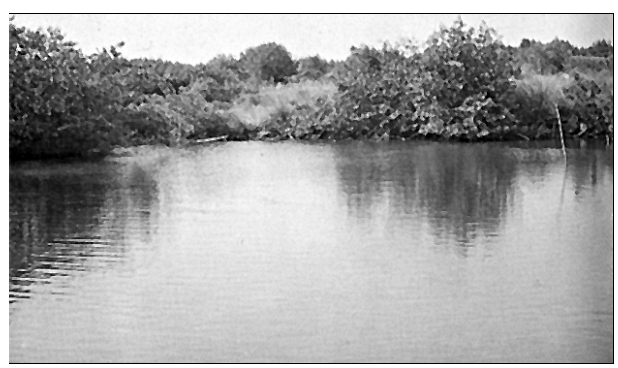
The story starts in late 1969 with a typically cryptic note from my good friend, Ross Socolof, of fish farm and general aquatic fame



Map of British Honduras/Northern Guatemala, showing places in which the author collected. The dashed line indicates travel via light aircraft; the hatched line indicates overland travel via Land Rover.

(those notes of Ross' are famous!), that said concisely and to the point, "Let's go to Guatemala!" In truth, I was not overly enthusiastic. The region that Ross was proposing we explore is the region of swordtails and mollies, fishes I am not particularly interested in. But the thought struck me — I had seen thousands of swords and mollies in dealer and hobbyist tanks in past years, but seeing them in the wild in their natural habitat began to intrigue me. Then, too, was the thought that this was also the land of cichlids, where the genus *Cichlasoma* was everywhere present. It was also the land of the Mayans, where ruins of the First Mayan Empire could be seen without the tangle of tourists littering the landscape with their pop bottles, and desecrating the mood with their Bermuda shorts. Finally, a good portion of the trip was to be spent in British Honduras, a country relatively little explored by aquarist types such as Ross and myself. Ah yes, what an adventure we would have!

After discussing the trip in detail with Ross, THE AQUARIUM's staff photographer, Andrey Roth, was invited to join us. Our fourth man was really our host, and a word of explanation is in order. Some 18 months prior to our trip, Ross received a letter from one Russel Norris, owner of the Renco Battery Co. in Belize City,



The brackish water lagoon on the outskirts of Belize City in which the team found peripheral (brackish water) fishes our first day in British Honduras. All photos by the author.

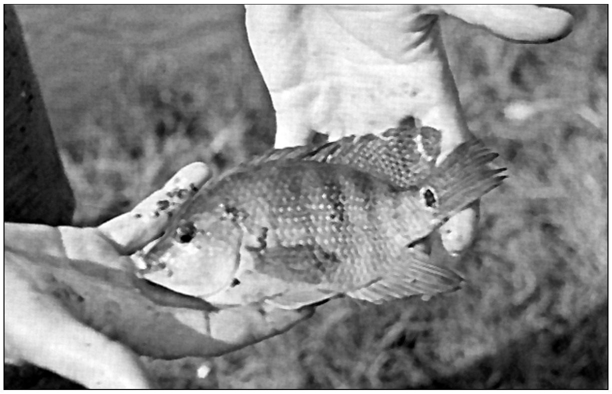
Russel Norris on one end of our two-man seine. Holding the net in one hand, his other hand grasps a line leading to the bottom of the net. By stepping on this line, the bottom of the net (which is also weighted with lead sinkers) is forced close to the mud bottom of the lagoon. The collector moves, as if using a crutch, shoreward in short steps.

British Honduras. Now Ross receives many letters from people all over the world, and it is understandable that he is not able to reply to but a tiny fraction of them. Ross doesn't know why, but this one he answered, and luckily for us all as Russel Norris proved to be a good friend, a warm, likeable human being, and a dedicated aquarist. From this point on, dear reader, I leave to you the problem of sorting out Russ, Ross, and Roth!

A few words about the ichthyofauna of northern Guatemala and British Honduras are in order. It is, first of all, a region rich in secondary freshwater fishes and relatively poor in primary freshwater fishes. By "primary" I mean those fishes that in general are unable to cross marine water barriers. Examples of such fishes include the characins and the catfishes. Secondary freshwater fishes, on the other hand, tolerate some salt water; examples are the cichlids and the poeciliid livebearers (mollies, swords, etc.). When I say "relatively poor" I am not talking about quantities in terms of weight, for one gets the impression that at least 50% of the biomass or weight of fish present in Central America is composed of but three or four species of characins! It is in the number of species that the cichlids and the livebearers overpower the tetras and catfishes. Thus, the preponderance of primary freshwater fishes in the area we would explore would consist of a few species of *Astyanax* and *Rhamdia*. The cichlids, on the other hand, would number over 70 species alone!

Writing in the December 1966 issue of Copeia, Dr. George S. Myers concluded that the entire area of Central America between the Isthmus of Tehuantepec and eastern Panama was and always had been devoid of primary freshwater fishes prior to the very late Tertiary age. In other words, middle Central America was protected from invasion by these primary fishes for a very long period of geological time. The barriers were mostly in the form of inundations by the sea. However, both cichlids and the livebearers (poeciliids) were able to cross these sea barriers, hence the large number of species of these fishes present. Only those characins (*Astyanax* mostly) and catfishes (*Rhamdia* mostly) known to be tolerant of salt were able to make the hurdle. Thus, we expected to find cichlids (particularly *Cichlasoma*) and livebearers in abundance of species, and we were not disappointed.

A catch of assorted brackish water fishes. Clearly seen in the center is a hogchocker, *Trinectes maculatus*.



One of the brackish water cichlids collected, tentatively identified as *Cichlasoma urophthalmus*.

My own part of the journey started with a brief stay at Ross' home in Bradenton, Florida, but we rendezvoused with Andy at Miami International airport so that the three of us left together for British Honduras. The flight was so under booked that there were about two stewards or stewardesses for each passenger — it was almost as if we had a chartered flight! We landed at Belize City where we were met by Russ Norris and his charming wife Dalila, who ushered us off in their Volkswagen bus to our base headquarters while in Belize, the Fort George Hotel. It was then that Russ told us he was taking a short vacation from his battery factory (leaving the business in the hands of his wife!) so that he could accompany us throughout our travels in British Honduras and Guatemala. This was a tremendous offer and we were absolutely delighted.

British Honduras, a country slightly larger than Massachusetts and with a population of about 114,000 people, is mostly swamps and forests (only about 10% of the land is suitable for farming). It is hot and humid, and the temperature several times reached 100°F in the shade during our visit. About 40% of the population is black, the remainder consisting of East Indians, Europeans, and Maya and Carib Indians.

Guatemala, upon gaining independence in 1821, claimed British Honduras. In 1859, some sort of agreement was reached between the two countries but in 1964, when Great Britain announced the British Honduran constitution, Guatemala broke off relations with Britain. Today the relations between British Honduras and Guatemala are cool but quiet. On Guatemalan maps, British Honduras is still shown as the Guatemalan province of Belize.

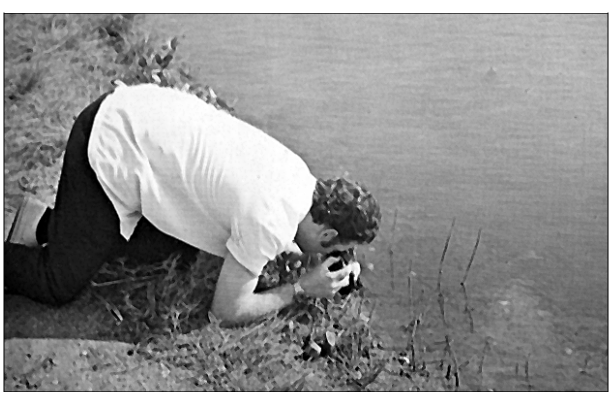
British Honduras is a country tormented by hurricanes. Belize City, its capital, a city of some 40,000 persons, has been hit so often by hurricanes that the Government is making plans to move the capital inland 50 miles. The country's economy is based upon agriculture - sugar, citrus, and lumber. It has 700 miles of roads (all bad!), no railroads except those owned by logging companies, and no television (the latter may be a blessing in disguise!). There is a ridge of mountains, known as the Maya Mountains, on a north-south axis in the southern part of the country. The highest point is Victoria Peak (3681 feet).

A really strange varmint that we collected—the needlefish, *Strongylura marina*. We also found this fish in pure salt water.

Collected in the bargain was one of the real old timers among aquarium odd-ball fishes, the puffer *Sphaeroides testudineus*.

Russel Norris holding part of a termite's nest found in an old cemetery (back-ground). The paths to collecting pools are sometimes strange indeed!

An afternoon arrival in British Honduras meant that we still had a few good hours of fishing before us. Ross, Andy, Russ and his wife, and I took off in the VW to try our hand in a brackish water coastal lagoon near a school on the outskirts of the city. Peripheral (brackish water) fishes were present in abundance. These included: hogchokers (Soleidae - *Trinectes maculatus*), needlefish (Belonidae - *Strongylura marina*), puffers (Tetraodontidae - *Sphaeroides testudineus*), and even crabs. A few hardy freshwater fishes were found also, including the pike livebearer (*Belonesox belizanus*, named after Belize City), *Poecilia sphenops*, and a fish resembling *Cichlasoma maculicauda*. These fishes were taken via our standard seining procedure; a two-man seine bearing into the shore, with a man near the shore muddying the waters and attempting to stampede the fishes into the net. The mud, a blackish, smelly mess, was such that in places a man would sink to his waist and have to be pulled out by his colleagues. It was here that my legs were badly scratched by submerged branches covered with thorns.



Our dedicated staff photographer, Andrey Roth, in action. If you can't get them to come to you, you go to them!

It was fortunate that I had had all my shots! Andy Roth, experimenting with a 55 mm Micro Nikkor lens on his Nikkormat FTN (a fantastic lens that focuses as close as 7 inches) almost got his nose wet photographing fishes that strayed to the surface near the shore. The bulk of the fishes caught here, however, did not do well (the puffers were the first to go) as the brackish water types require much oxygen. This first attempt served primarily to test our equipment and our techniques. The serious fishing was yet to come.

Returning to town we met Charles Nord and his wife, Ruby, who suggested that we try a spot about 10 miles from Belize City. This we did (after an abortive attempt at crossing a cemetery on foot and collecting, for our pains, only a termite's nest!), and the creek turned out to be a dandy. Because of the low water (we were then in the remaining weeks of the dry season) situation, we found the fish concentrated at the surface of the water. Indeed, the surface seemed literally to boil with fish. From this spot we took *Poecilia sphenops*, an *Eleotris* or related species that we first mistook for *Hoplias malabaricus* (a fish not found in British Honduras), and at least three species of *Cichlasoma*, tentatively identified as *C. urophthalmus, C. affine*, and *C. friedrichsthalii*. We dubbed the habitat, "Charles' hole," and retired with our day's catch to Belize City.

Part of a fisherman's catch, consisting of *Petenia splendida*. This fish exists in a pure red form, much like the more familiar red devil.

In Quest of the Mayans – Part II

[The Aquarium, January 1971]

As I reported that the first chapter of our chronicles in the land of the Mayans was written while in the Virgin Islands, readers may well be somewhat skeptical as I state that this second chapter is being written from the veranda of my cabin at the Hacienda Chichen in Yucatan, Mexico! Next week I am slated to deliver apaper ("Studies On The Detection Of Enteric Pathogens in Solid Waste And Waste Residue") before the Tenth Congreso Internacional de Microbiologia in Mexico City, but for the time being my wife and I are roving about the Mayan ruins and cenotes (underground water holes) of Yucatan - a sort of busman's holiday for me!

A view of the wharf at Belize, Capital of British Honduras.

Be that as it may, the hot, muggy weather here in Yucatan brings back vivid memories of our second day in British Honduras. We left our hotel at 8 AM and proceeded to downtown Belize where Andy planned to hunt up a visa for Guatemala while Russ searched for a cast-net thrower. This was the day we were to explore Mussel Creek, a tributary of the Belize River located about 15 miles northwest of the city. Finding a fisherman who could handle a cast net was a problem, however. While Russ and Ross trundled through the market looking for a native who had been recommended as a possibility, Andy and I prowled through the stalls of the vendors and along the wharf area. The latter was teeming with numerous single-masted fishing vessels, each unloading its wares. It was an informal procedure. Indeed, often fish would be taken from the boats and promptly sold a few feet away on the bare wood of the edge of the wharf. It was hot, and many women carried parasols to shade them from the sun. The market itself was a typical kaleidoscope of colors, aromas, and sounds, if readers will permit me to foul up a metaphor or two!

An old aquarium friend, the Jack Dempsey. Note the author's explanation of a name change for this fish (*Cichlasoma octofasciatum*).

Editor's Note: The layout person used the wrong picture and a correction was made in the March 1971 issue. The fish is NOT the Jack Dempsey. AJK

We sought in vain for a cast-net fisherman. However, Russ did produce a cast-net, a rather expensive circular net weighted with lead sinkers around its periphery and taking considerable skill to manipulate properly. Russ decided to try his hand at it, and we proceeded to obtain Andy's visa. While the others went to the Guatemalan Consulate's office, I stayed and guarded the Volkswagen bus. Shortly afterwards I struck up a conversation with a passerby who offered to sell me an island off the coast of British Honduras for $15,000! Not carrying that much spare change in my pockets (I lacked about $14,990 of it), I had to pass up the opportunity but I must say for the record that, next to the Great Barrier Reef of Australia, British Honduras has the finest coral reefs in the world.

At 10 AM, Andy's visa in hand, we left Belize. Our first stop was the spot we had visited the day before and had christened "Charles' Hole." The fish here (mostly livebearers) were dying of oxygen starvation. As the dry season progresses the water evaporates, concentrating a mass of fishes into a small area. Breaking the surface to obtain air, the water was "boiling" with these poor unfortunate animals that were doomed to die. It was ironic to note that the pool contained at least $5,000 worth of good aquarium specimens, if only they could have been transported to the States alive.

On our way to a body of water known to contain Cichlasoma salvini, we passed a fisherman holding a respectable catch of some sort of cichlid, 7 or 8 inches in length. These turned out to be the "bay snook," the local name for *Petenia splendida*, a grayish-white sort of fish sporting numerous dark zigzag markings and a line of dark spots from gill cover to caudal peduncle. The fascinating thing about this was that a native fisherman friend of Russell's had told him that a pure, brilliant red form of the fish was found in a lake 60 to 70 miles northwest of the city! We vowed to go there later in our trip, but it would have to be by air as it was almost inaccessible otherwise.

The *salvini* site proved to be a small creek, thickly overgrown with brush and impossible to seine. Ross commandeered two hand nets and promptly disappeared into the tall grass. A few seconds later he bellowed like a bull

One of the beautiful cichlids caught at Mussel/ Creek. The bright red head of this fish seems a bit unreal!

One of the prettiest cichlids in British Honduras is *Cichlasoma salvini*. This mustard-and-red fish keeps to a fairly manageable size, and is striking. As with many fishes just-caught, the colors of this salvini are gorgeous but typical!

moose - he had struck cichlid pay dirt! Jabbing the hand nets beneath the deeply undercut banks, Ross was pulling out cichlids faster than we could bag them. *Cichlasoma salvini* certainly was among them. This is a beautiful creature indeed. Through the efforts of Ross Socolof who is now raising them in pools at his fish farm in Bradenton, Florida, it will become widely distributed and sure to establish itself as a real favorite. In truth, it rivals the mbuna cichlids of Africa, and is easier to breed (not being a mouth brooder).

Although it was hot (and I mean *hot!)* the thick brush and deeply undercut banks protected these fishes from the sun. Accordingly we encountered none of the oxygen starvation that characterized Charles' Hole. The fish here were in excellent condition. Other cichlids collected included *Petenia splendida* (but no red specimens here), *Cichlasoma octofasciatum, C. trimaculatum* (or perhaps *C. maculicauda?), C. urophthalmus,* and *C. friedrichsthalii.* Other fishes included *Gambusia,* mollies, and *Astyanax fasciatus.* Later in the day we discussed the relative frequency of these fishes as we found them. The most common cichlid was *C. urophthalmus,* with *C. friedrichsthalii* a close second. Regardless of the many different species of *Cichlasoma* caught that day 50% of the biomass of the catch consisted of the ubiquitous *Astyanax.* We noted that a tremendous variation existed between cichlid juveniles and adults (this was the dry season of the year; hence no fry were found here). C. *salvini* is a good example. Some were predominately yellow; others were mostly green. It might be wondered how it is that so many different species of *Cichlasoma* are found in a single, confined habitat. The explanation is that each one occupies its own ecological niche, much like the mbuna of Africa. We were careful therefore, to note where the net went on each pass and what it produced. These are small details indeed, but something the serious student of fishes does not overlook.

While we are on the subject of the fishes recovered from this habitat, a few remarks about *Cichlasoma octofasciatum* are in order. Six years ago, while subjecting several preserved specimens of the Jack Dempsey to microscopic examination, I noticed that their counts and measurements did not coincide to the clas-

This is a net-full of assorted cichlids obtained from one swipe of the net! British Honduras is a cichlid-lover's paradise indeed. A serious cichlid fancier could go into shock just by handling this many new cichlids for a few minutes!

Believe it or not, this is Ross Socolof standing in our cichlid habitat, scooping out the goodies net after net. It would be a bit idiotic to say, "Notice the heavy brush"!

sical description of *Cichlasoma biocellatum.* A little investigation of the literature led me to conclude that the Jack Dempsey was *Cichlasoma octofasciatum.* But, how could this be? *C. octofasciatum* is a Central American fish and we all "knew" the Dempsey came from South America. Four years ago I brought these findings to the attention of an ichthyologist friend of mine who said that Drs. Myers and Rivas were in the process of publishing a paper about this. As a matter of professional courtesy, I put aside my own publishing plans but mentioned the fact to a few cichlid specialists with the caution that as a matter of ethics they not publish the information until after Drs. Myers and Rivas had published their manuscript. One self-made armchair "expert" of late, however, saw fit to violate this matter of ethics and the name is now in print so that there is no reason now to delay the following remarks.

The Jack Dempsey is found in Central America on the Atlantic slope from the Rio Paso San Juan (20 miles west of Veracruz City, Mexico), to Honduras. It is also found in the Yucatan where it was originally described as a separate species, *Cichlasoma hendricki.* The confusion about the name occurred when Eigenmann stated that some *Cichlasoma biocellatum* came from Costa Rica. However, C. *biocellatum is* South American - the Rio Negro in the Amazon. Oddly enough, in the early days of the hobby the Jack Dempsey was also confused with C. *nigrofasciatum!* Ross Socolof informs me that Jack Dempseys have a fantastic resistance to the cold; often they are the only fish to survive those occasional Florida freezes that wipe out thousands of other species.

At about 12 noon we proceeded to Boom, a small settlement on a poor road not too far from the Belize River almost due west of Belize City, for the purpose of securing a dingy and an outboard motor. We had, unfortunately, a flat tire. Further, the socket on the side of the van into which the jack is ordinarily inserted was filled with dirt so that our jack was inoperable. We solved the problem by digging out underneath the wheel with a piece of wood. All this took place in a heat that was about 100° F in the shade, and I came as close to heat prostration then as I have on any of my trips. It was a terrible time to think of it, but I recalled that in British Honduras, all soft drinks are referred to as "lemonades," regardless of the flavor! (In Ecuador they are called

Russel Norris releasing his cast-net from a bridge. This is a perfect throw and the net has billowed out to a full circle. Russ maintains contact with the net by means of a center cord.

“colas” and in Peru “gaseosus” the latter a most apropos term!)

Tire fixed and boating equipment secured, we re-boarded the VW. The presence of the boat inside the VW, however, presented problems. Ross and Andy were buried beneath the boat somewhere in that 100° F heat, while I was positioned about 1-inch away from the front windshield with the point of the boat stuck in my back. Travel this way was torturous but we wended our way to a native establishment where we secured sandwiches and “lemonade” that, at the time, seemed to match the baronial splendor (as Ross put it) of our rooms at the Fort George Hotel in Belize. In times of great need, even dry bread with a slab of cheese on it is manna from heaven!

Our next stop was a creek we named “Russ’ Hole” where we were “assisted” by a group of native boys who were swimming in their birthday suits (at 100° F, what else?). Here Russ tried his hand at the cast-net, and he did a creditable job indeed. This was the first time I had witnessed its use close up. It takes a great deal of skill to use, and it is dramatic to watch as the net billows to a full circle in mid-air when properly thrown. The sinkers then force it to the bottom in cuplike fashion, trapping the fish in its path. The net is retrieved by pulling on a cord attached to the center of the net.
The spines of the fish are caught in the net meshing, and they are collected along with the net. It worked well for Russ.

The native lads assisting us taught us some local names for our fishes. The livebearers were called “poopseek” (POOP-SEEK’); characins in general were referred to as “belum” (BAY-LUM’). Three cichlids were identified especially. *Cichlasoma affine* was called “shesheek” (SHE-SHEEK’), and C. *salvini* was called “parrot fish” although we think that “parrot cichlid” is a bit more descriptive. Lastly, *C. trimaculatum* was commonly referred to as “tuba”

One interesting life drama unfolded before my eyes at Russ’ Hole. The creek narrowed down to about 3 feet across at one point, at which it was blockaded (by the native boys) by a log. The characins *(Astyanax)* would concentrate at this log, and when disturbed would jump out of the water and over it. At times, literally dozens of characins would be up in the air! Finally, a swarm of bees arrived on the scene and tormented us excessively, even following us to the VW where we locked ourselves in to escape their stings. Such are the hazards of fish collecting!

Our final fishing of the day was done in Mussel Creek, which connects the Laguna de Cox with the river Rio Chuelo Balck. Here we caught a fantastically colorful cichlid - bright red head with a bluish-green body. Larger than *C. salvini,* it is a more striking fish. Incidentally, our identifications are still being verified by professional ichthyologists, and are tentative for the time being. There are so many cichlids obtainable in British Honduras that it will be months before this work is completed. Accordingly, I have appended a checklist of all

Native boys assisting Ross Socolof at Russ' Hole, near Boom, British Honduras.

CHECKLIST OF CICHLIDS OF CENTRAL AMERICA

(Species marked with asterisks are those within range traveled by the authors and in which fish were collected)

I
Aequidens coeruleopunctatus
Atlantic slope of central and eastern Panama, Pacific slope of Costa Rica (Bussing) and Panama, thence (doubtfully) to Colombia.

II
Geophagus crassilabri
Both slopes of central and eastern Panama.

III A. *Cichlasoma,* section *Theraps:*
1. *Cichlasoma eigenmanni*
Rio Tonto and its tributaries in the Rio Papaloapam basin, Mexico.
2. *Cichlasoma nebuliferum*
Atlantic slope of southern Mexico (Rio Coatzacoalcos to Rio Grijalva?).
3. Cichlasoma maculicauda*
Atlantic slope from the Rio Usumacinta basin, Peten, Guatemala, to Panama (Rio Chagres).
4.* *Cichlasoma melanururn*
Rio de la Pasion and Lake Peten and adjacent lakes, Guatemala, and Belize River, British Honduras.
5. Cichlasoma synspilum* Atlantic slope from Rio Usumacinta basin, Guatemala to Belize River, British Honduras (may not be distinct from C. *melanurum;* includes C. *hicklingi).*
6. *Cichlasoma fenestraturn*
Atlantic slope of Veracurz (Rio Chachalacas basin) and Oaxaca, Mexico, not east of the Rio Coatzacoalcos.
7. *Cichlasoma sexfasciaturn*
Known only from "Guapote, Mexico."
8.** Cichlasoma bifasciaturn*
Rio Usumacinta basin in Peten, Guatemala and adjacent parts of Mexico.
9.** Cichlasoma heterospilum*
Rio Usumacinta basin in Guatemala and Mexico.
10. *Cichlasoma guttulatum*
Pacific slope of Middle America from Rio Tehuantepec, Oaxaca, Mexico, into Guatemala; Atlantic slope only in Rio Coatzacoalcos basin, Mexico (includes C. *zonaturn).*
11*. Cichlasoma godmani*
Atlantic slope of Guatemala (Rio Polochic basin, Lake Izabal, Sulphur River near Puerto Barrios).
12. *Cichlasoma microphthalmum*
Rio Motagua basin on the Atlantic slope of Guatemala (includes *C. oblongum, C. milleri,* and C. *caeruleogula).*
13. Cichlasoma gadowi
Rio Tonto and tributaries, Rio Papaloapam basin, Mexico.
*14.*Cichlasoma intermedium*
Basins of the Rio Usumacinta in Guatemala and Mexico and of the Rio Grijalva, Mexico (includes C. *anguiliferum*).
15. Cichlasoma sieboldi Pacific slope of Costa Rica to central Panama; possibly Atlantic slope of Panama (includes *Herichthys underwoodi).*
16. *Cichlasoma irregulare* Upper tributaries of the Rio Usumacinta in Mexico and Guatemala and the Rio Polochic drainage, Guatemala.
17.*Cichlasoma *lentiginosum*
Rio Usumacinta basin in Guatemala and Mexico.
18. Cichlasoma balteatum Great Lakes of Nicaragua (synonym of C. *n icaragu ense?).*
19. Cichlasoma nicaraguense
Great Lakes of Nicaragua (includes C. *balteatum ?).*
18. *Cichlasoma* sp.
Rio de la Pasion (Rio Usumacinta basin), northern Guatemala.

III B. *Cichlasoma,* section *Archocentrus:*
1.* *Cichlasoma spilurum*
Atlantic slope from Belize River, British Honduras, southward to Bocas Province, western Panama; also on Pacific slope of Costa Rica (includes *C. cutteri).*
2. Cichlasoma nigrofasciatum
Pacific slope of Guatemala to Costa Rica; both slopes of Costa Rica.
3. Cichlasoma octofasciatum*
Atlantic slope from Rio Paso San Juan (20 miles W of Veracruz City), Veracruz, Mexico to Honduras (Rio Ulua basin); also in Yucatan Peninsula (includes C. *hedricki).*
4. *Cichlasoma centrarchus*
Atlantic slope from the Great Lakes and Rio San Juan, Nicaragua into Costa Rica.
5. *Cichlasoma immaculatum*
Rio Polochic basin, Atlantic slope of Guatemala.
6. *Cichlasoma spinosissimum*
Rio Polochic basin, Atlantic slope of Guatemala.

III C. *Cichlasoma,* section *"Herichthys":*
1. *Cichlasoma bocourti*
Lake Izabal and lower Rio Polochic, Atlantic slope of Guatemala.
2*. Cichlasoma geddesi*
Atlantic slope of southern Mexico.
3.** Cichlasoma pearsei*
Atlantic slope of Mexico and northern Guatemala in the Rio Usumacinta basin, including Rio Champoton, Campeche, Mexico.

III D. *Cichlasoma,* section *Amphilophus:*
1.* *Cichlasoma robertsoni*
Rio Coatzacoalcos basin, Veracruz, Mexico southward along the Atlantic slope to 30 miles E of Tela, Honduras (includes C. *acutum).*
2. *Cichlasoma longimanus*
Great Lakes of Nicaragua.
3. *Cichlasoma macracanthum*
15. Pacific slope of Mexico (Rio Tehuantepec basin) southward to El Salvador (Rio de *Paz* basin).
4. *Cichlasoma guija*
Rio Lempa basin of El Salvador and extreme southeastern Guatemala.
5. *Cichlasoma heterodontum*
Pacific slope streams of the Isthmus of Tehuantepec, Oaxaca and Chiapas, Mexico (includes C. *evermanni).*
2. *Cichlasoma altifrons* Pacific slope of western Panama and Costa Rica.
3. *Cichlasoma rostratum* Great Lakes of Nicaragua to the Atlantic and Pacific slopes of Costa Rica.
4. *Cichlasoma popenoei* Rio Choluteca basin, Pacific slope of Honduras.
9. Cichlasoma margaritiferu m*
Known only from the type, from the Peten region of Guatemala.
10. *Cichlasoma citrinellum*
Atlantic slope of Nicaragua

(including the Great Lakes basin) *and* Costa Rica.
11. *Cichlasoma erythraeum*
Great Lakes of Nicaragua (possibly the female of C. *labiatum* or the same as C. *citrinellum).*
12. *Cichlasoma lobochilus*
Great Lakes of Nicaragua.
13. *Cichlasoma alfaroi*
Both slopes of Costa Rica, Atlantic slope of western Panama (includes C. *lethrinus).*
14. *Cichlasoma labiatum*
Great Lakes of Nicaragua (possibly the female is C. *erythraeurn).*
15. *Cichlasoma tuyrense*
Pacific slope of eastern Panama (Rio Bayano, Rio Tuira).
16. *Cichlasoma* sp.
Pacific slope of Guatemala; relative of C. *heterodon turn.*
17. *Cichlasoma sp.*
Rio de la Pasion and Rio San Pedro, in Rio Usumacinta basin, Peten, Guatemala.

III E. *Cichlasoma,* section *"Paraneetro plus":*
1. *Cichlasoma bulleri*
Atlantic slope of southern Mexico from the Rio Papaloapam to the Rio Grijalva basins.

III F. Cichlasoma*,* section *Parapetenia:*
1. *Cichlasoma mento*
Southern Mexico (Rio Negro).
2. Cichlasoma urophthalmus*
Atlantic slope of Middle America from the Rio Coatzacoalcos basin southward into Nicaragua (including Yucatan Peninsula and Isla Mujeres).
3. Cichlasoma hogaboomorum
Lower part of the Rio Choluteca, Pacific slope of Honduras.
4.* *Cichlasoma trimaculaturn*
Pacific slope of Middle America from Laguna Coyuca NW of Acapulco, Mexico southward to Rio Lempa, El Salvador (includes C. *mojarra, C. centrale, C. gordonsmithi* and C. *cajali).*
5. Cichlasoma tenue
Rio Papaloapam basin, Atlantic slope of Mexico.
6. Cichlasoma salvini* Atlantic slope from Rio Papaloapam, Veracruz, Mexico southward to Sulphur River near Puerto Barrios, Guatemala.

7.* *Cichlasoma friedrichsthali*
Atlantic slope of southern Mexico *(*east of the Rio Coatzacoalcos) to Costa Rica.
8. *Cichlasoma managuense*
Great Lakes of Nicaragua and Atlantic slope of Costa Rica.
9. *Cichlasoma dowi*
Great Lakes of Nicaragua and both slopes of Costa Rica.
10. *Cichlasoma motaguense*
Atlantic slope of Guatemala (Rio Motagua), Pacific slope of Guatemala, El Salvador, and Honduras. (Synonym of C. *friedrichsthali?.*
11. *Cichlasoma* sp.
Rio Grande de Chiapa basin (Rio Grijalva system), Chiapas, in Atlantic drainage of Mexico.
12. *Cichlasoma* sp.
Rio Comitan and adjoining lakes, Chiapas, Mexico, and interior stream draining toward the Rio Usumacinta basin.

III G. *Cichlasoma,* section *Thorichthys:*
1. *Cichlasoma callolepis*
Upper tributaries of the Rio Coatzacoalcos basin on the Atlantic slope of the Isthmus of Tehuantepec, Mexico.
2.* *Cichlasoma aureum*
Atlantic slope, from the basin of the Rio Chachalacas, northwest of Veracruz City, Mexico, eastward and southward to the Rio Polochic-Lake Izabal and Rio Motagua basins, Atlantic slope of Guatemala and adjacent Honduras; possibly also in British Honduras.
3. *Cichlasoma ellioti*
Upper tributaries of the Rio Tonto in the Rio Papaloapam basin, Veracruz, Mexico. (Possibly the same as *C. helleri).*
4. *Cichlasoma helleri*
Rio Grijalva basin, Atlantic slope of southeastern Mexico (range and status not clear).
5. Cichlasoma champotonis*
Rio Grijalva-Usumacinta and Rio Champoton basins in northern Guatemala and southeastern Mexico.
6. Cichlasoma affine*
Lake Peten and nearby lakes in Peten, Guatemala to Rio Grijalva basin, Mexico.

7*. Cichlasoma meeki*
Northern part of the Yucatan Peninsula.
8. Cichlasoma hyorhynchum*
Rio Usumacinta basin, northern Guatemala and Belize River, British Honduras.
9. Cichlasoma pasionis* Rivers and lakes of Peten (Usumacinta basin), northern Guatemala.

III H. *Cichlasoma,* miscellaneous
1. *Cichlasoma calobrense*
Pacific slope of the eastern half of Panama (Rio Bayano, Rio Tuira).
2. *Cichlasoma spiloturn*
Atlantic slope of Costa Rica.
3. *Cichlasoma umbriferum*
Pacific slope of eastern Panama (Rio Tuira) and Atlantic slope of Colombia (Rio Atrato, Rio Magdalena).
4. *Cichlasoma terrabae*
Pacific slope of Costa Rica.
5. Cichlasoma *tuba*
Atlantic slope of Costa Rica (includes *Tomocichla underwoodi).*
6. *Cichlasoma* sp.
Upper part of the Rio Coatzacoalcos basin, Atlantic slope of the Isthmus of Tehuantepec, Mexico.
7. *Cichlasoma* sp.
Rio Seniso near Coban, in Rio Usumacinta basin, Guatemala (Hubbs, 1950: 11).
8. *Cichlasoma* sp.
Upper tributaries of Rio de la Pasion (Usumacinta basin), Guatemala.

IV
Petenia splendida
Atlantic slope from the Rio Grijalva basin to the Rio Usumacinta and the Belize River, in southeastern Mexico, northern Guatemala, and British Honduras.

V
1. *Neetroplus nematopus*
Atlantic slope of Nicaragua (Great Lakes) and Costa Rica.
2. Neetroplus panamensis
Atlantic (Rio Chagres) and Pacific (Rio Tuira) slopes of Panama.

VI
Herotilapia multispinosa
Atlantic slope of Nicaragua (Great Lakes) and Costa Rica.

the cichlids of Central America to this chapter, with those found in the areas we visited identified by asterisks. The list was devised by Dr. Robert R. Miller of the Museum of Zoology, University of Michigan, and even contains several unidentified specimens.

The cichlids (and large characins) were obtained at Mussel Creek by Russ who again used the cast-net (which, by the way, cost about $100!). One man was needed to man the outboard motor, and Andy volunteered. Everything went well until the boat slowed down and Andy complained of "loss of power." At this point we determined that he was trying to plow through mud, not water! It is amazing how "deep" 8 feet of mud can look when it is covered with 3 inches of water.

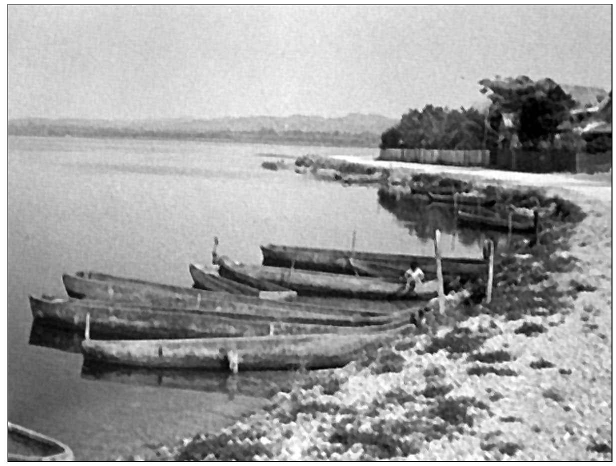
We left Mussel Creek at about 3 PM and proceeded once again to Boom to return the boat and motor. Our next stop was Russ' home where we berthed the fish we had caught in his holding tanks. Tomorrow was to be a long day, for we were off to the northern territories of Guatemala and the fabulous Lake Peten.

In Quest of the Mayans – Part III

[The Aquarium, February 1971]

After an early breakfast, Russ Norris met us Sunday Q morning with a borrowed Land Rover which was to be our transportation to Guatemala. Our plans were to take the highway leading through Roaring Creek, Cayo, and Benque Viejo in British Honduras to cross the border at Melchor de Mencos, and to continue on to Flores, an island situated in Lake Peten inn the northern lowlands of Guatemala.

Loading a vehicle such as a Land Rover for a serious collecting trip requires great precision, experience, a sense of organization, care, and foresight. Thus it was that considerable attention was paid to our most important item of cargo, a polyfoam fish box filled with beer and



Canoes moored on the banks of Flores in Lake Peten.

ice. Oh yes, there were a few other things loaded in the rear of the truck - hand nets, seines, plastic boxes, formalin, polyfoam boxes, fish spears, cameras, diving gear, etc. Once having loaded the "cerveza" (the Spanish word for beer), these additional miscellaneous minor items could be accommodated!

At this point, I made a tactical error in the form of volunteering to ride in the rear of the Rover (there being room for only three up front). The Rover had a metal cab but the rear was covered with canvas, certainly not a dust-proof arrangement by any means. As the roads we traveled consisted of almost pure limestone, by the end of the journey I resembled Grandfather Frost (If I ever make 70, now I know what I will look like!). Everything was covered with chalk dust. Fortunately, our most valuable and delicate equipment was closed in plastic fish bags. Thank goodness for those bags! Typically, they mean much more to a fish collector than merely something in which to transport his catches!

One of my chief problems was keeping the foam top on the cerveza box. Central American roads topographically resemble a magnified seersucker cloth and everything and everyone bounces. A mile on a Guatemalan or British Honduran road is sufficient to churn

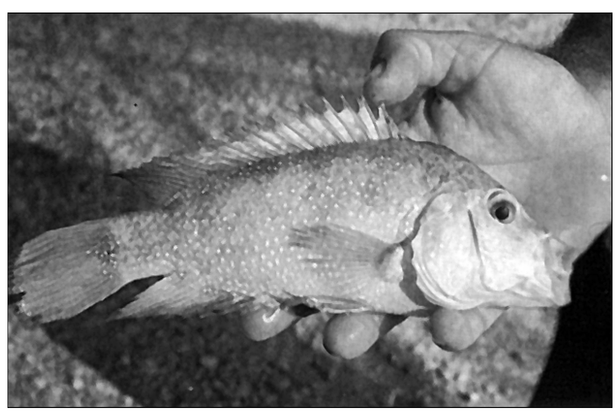
The author seining for cichlids in a Lake Peten inlet.

butter, and to cure "irregularity" (as the ads say). However, the fellows in the cab had a problem too — me. It turned out that when I smoked a cigar in the back, in a sense everyone up front smoked a cigar also. Such were the airflow patterns in a Land Rover, buttoned up against the chalk dust of these tropical roads. Incidentally, as this was limestone country par excellence, and since the same material formed the support for rivers, lakes, ponds, and streams, the water was hard. Any aquarist preparing soft, acid water for the fishes taken from this region is either a nut or else holds stock in a limestone quarry!

We made numerous exploratory stops along the way, noting those sites we would fish on the way back. We saw numerous livebearers and cichlids (particularly *Cichlasoma intermedium*), but this was to be expected, as the Land of the Mayans is also the land of these two groups of secondary freshwater fishes. After passing Roaring Creek, we stopped and visited with Russ' parents who owned a rather substantial cattle ranch in the bush. The ranch somewhat resembled a movie set, one of those British Colonial epics where the white men go about in pith helmets and white Bermuda shorts, sipping gin and tonic. This, however, was the real thing and to me was more exciting than any movie I had ever seen. We enjoyed the hospitality and the conversation of the Norris family, and we regretted it when our schedule forced us to take our leave.

Shortly before crossing the border, we lunched at Cayo where the meal consisted of rice, chunks of beef, and the omnipresent beans, washed down with cerveza or a soft drink. (Incidentally, most travelers drink bottled beverages while in Latin America to avoid enteric problems. Should they come down with diarrhea, they then blame the food. What they are forgetting, however, is that the main transmitter of enteric pathogens is simply the local currency. Most bills are filthy, and handled by everyone including those who transmit these pathogens. Thus the traveler who neglects to wash his hands before eating is courting trouble. Worry more about the germs on the money than on the germs in the local water!)

When we reached the border, the customs check on the British Honduran side was perfunctory (as such inspections usually are when leaving a country). The Guatemalan border officials, however, were on their lunch break and Russ was permitted by a solitary soldier guard to cross the border on foot to look for them. While clearing customs (a simple matter — Latin American customs officials are usually friendly and courteous, but they do work slowly!), we met the Governor of Peten Prov-



One of the cichlids collected in Lake Peten (perhaps *Cichlasoma lentiginosum*?).

Another cichlid collected in Lake Peten (perhaps *Cichlasoma melanurum*?).

ince and the owner of the hotel at which we hoped to stay while in Flores. Booking rooms is always an “iffy” proposition in isolated areas of Latin America, especially without advance reservations, but here we made our reservations 4 hours before we even got there!

Once in Guatemala, the road dust changed from brown to white. Oddly enough, the roads in Guatemala were better than those in British Honduras, but they still left a lot to be desired as they were dirt (limestone) roads all the same. As is now almost universally recognized, tropical soils which are permanently deprived of their forest cover quickly decline in fertility and become quite unworkable as a layer of brick-like laterite develops on the surface. Tropical rainfall and a fierce sun do their destructive work in a surprisingly brief span, and agricultural disaster results. Under such conditions, about the only kind of farming possible here in the Guatemalan lowlands is a kind of shifting, slash-and-burn system under which the forest is permitted to regenerate at intervals. While seemingly simple, it requires great experience on the farmer’s part. A patch of forest on well-drained land is chosen, and cut down in late autumn or early winter. The felled wood and brush are fired at the end of the dry season (the period we were there), and all over the lowlands the sun becomes obscured by the smoke and haze that covers the sky at that time. Thus it was that my first impression of Guatemala was that of monumental air pollution. Smoke and the smell of burning brush were everywhere.

Just before reaching the bridge that afforded access to Flores, we encountered a vehicle road check. While Russ was exhibiting his papers to the official, I noticed a sign over a gasoline station (the only station we had seen in 4 hours) that read: “Your Welcome Gringos - English Spoken.” Oh well, their intentions were good! We crossed over the bridge into Flores, a small town situated on an island. The proper name of the lake, Lago de Peten Itzá, is after an ancient group of people known as the Itzá (accent on the “a”). In 1200 AD the Itzá were driven from their homeland in Mexico and wandered through the empty jungles to the region of Lake Peten. On an island in the midst of the lake they established a new capital called “Tayasal” which is now Flores, the chief town of northern Guatemala. Tayasal, by the way, was one of the last cities to be conquered by the Spaniards. It seems beyond belief that Tayasal fell to the conquistadores only in 1697!

Five minutes after checking into our hotel we were in the water with our snorkels and masks,

Temple I at Tikal.

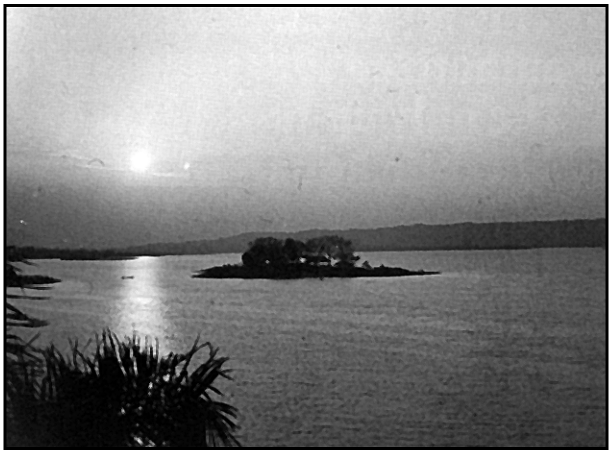
Temple II. In the background closest to Temple II is Temple IV; the one farther away is Temple III.

although my first objective was to wash some of that chalk dust from my skin. Andy was enthralled by the prospect of staring at Lake Peten mollies and cichlids only a few inches away from his facemask, and didn't get out of the water for hours. It is a bit of a thrill to see a pair of cichlids taking care of their young, right in their natural habitat. We discovered a number of fishes, including *Cichlasoma aureum, C. urophthalmus, C. salvini*, and an *Astyanax* species. Andy caught mollies 5 to 6 inches long, and numerous *Gambusia*-like fishes. He baited a trap with shells found on the lake bottom but oddly enough, the characins pushed away the cichlids through the sheer thrust of their numbers. To add insult to injury, only one characin wound up in Andy's trap!

The shore on this side of the island was rocky and punctuated with sharp shells of various sorts. After going out about 6 feet, the bottom disappeared. Russ actually dove to a depth of about 25 feet. On the other side of the island, the bottom was muddy and the slope much less abrupt. In these muddy areas, strands of giant val grew in profusion.

We discovered that we had arrived in Flores during the middle of an 8-day religious holiday, and across the lake in San Benito a festival was taking place that evening. Russ, Andy, and I drove over in the Land Rover and strolled around. It was a carnival atmosphere, complete with booths, rides, music, and crowds of people. Unexpectedly, we met Russ' brother-in-law who promptly invited us to his house where a small party was taking place. We were treated to a most friendly reception. A number of important people were there including the chief customs officer for the Province, and several administrators for FIDEP, a government organization involved in the development of Peten Province (schools, roads, etc.). We discussed politics and a host of other things quite candidly. As a result, I don't think I'll ever believe an American newspaper again (especially the NEW YORK TIMES!). The hogwash you read here just doesn't jibe with what I saw and heard. For one thing, the Guatemalan guerrilla activity is limited to the vicinity of Guatemala City, in the southern portion of the country. The people of northern Guatemala do not support the guerrillas, and consequently they cannot operate there. I remember shortly before undertaking this trip that some of my friends feared for my safety, as this was about

Andy Roth, standing between a stela and a Mayan calendar (the circular stone. The stela depicts a Mayan official.



Sunset on Lake Peten.

the time the guerrillas were kidnapping foreigners and holding them for ransom. Ironically, while in Guatemala, the Kent State riots and killings took place and truly, I felt safer and more at peace in Guatemala than I did when I returned home! In any event, if Guatemala progresses economically, it will be because of organizations such as FIDEP, not because of Castro-supported guerrillas. To American newspaper reporters, I would suggest that they get their gluteus maximi out into the countryside, and not spend all their time in Guatemala City bistros.

Somehow I wound up drinking a mixture of Scotch and strawberry soda (the Guatemalans are not particular about their chasers!) and, feeling no pain, we all returned to the festival. After a while Andy and I decided to take a canoe ferry back to Flores where we turned in for the night. Our night's sleep was disturbed by a rude and raucous rooster, situated below us in the courtyard, who insisted upon crowing from 3 to 6 AM. How I wanted to drop a brick on the head of that bird! When we woke up Ross and Russ, the latter's eyes looked like the belly of *Cichlasoma salvini* in breeding color. Such are the consequences of reunions with relatives in Latin America!

Leaving Russ to adjust himself to the idea that he was still alive, the rest of us had breakfast and started fishing. We fished the east side of the island with seines and hand nets without much success, however. The cichlids escaped among the rocks, and we could not keep the lead-weighted bottom of the seine flush against the bottom of the lake. In San Benito we had better luck for there we encountered a more or less mud bottom in a small inlet used by the lake ferry canoes. Our "take" here consisted of the now familiar livebearers and cichlids. One *Poecilia* type was sprinkled with fine black spots near the posterior portion of the body. All in all, however, few suitable aquarium fishes were caught.

Upon return to the hotel, Andy and I prepared to leave in the Rover for Tikal. Russ warned me about accidents in Guatemala, and advised that, if involved in an accident to lie on the ground and yell for an ambulance. It seems that in Guatemala, the police throw both drivers into the pokey until things can be straightened out. As this may take days, Russ pointed out the advantages of spending that time in a nice, clean hospital bed rather than in a dirty, smelly jail!

I remember reading somewhere a review criticizing a "travel" type of aquarium article because it digressed from a strict discussion of fish. He seemed to feel that such articles should be 100% about fish. What such reviewers forget, however, is that a hobby is a mixture of many things, not all of which pertain (in our case) to fish per se. A hobby in a sense includes all that it involves us in. I know one couple who regularly attend the meetings of our local aquarium society and who do yeoman work on committees, shows, etc., but who keep only one aquarium at home! They are primarily interested in people. Is it for us to say that they are not "aquarists"? One of the big kicks I get from my travels to Latin America is in visiting Indian tribes. It is not the primary purpose of these trips, but if it were not for the hobby, I would not have these opportunities to broaden my interests and horizons. So, with a "by your leave" to armchair critics who have never left the security of their basement fish-rooms to experience other aspects of this marvelous hobby of ours, I digress now to Tikal.

Tikal, which survived from 416 to 869 AD, was the largest of the Mayan cities. It rests upon a gigantic limestone outcrop, and the surrounding forest is as thickly treed as the Amazon. Cedars, mahogany, palms, and strangler ficus are dominant. Jaguars, tapirs, and snakes prowl the jungle floor, while monkeys and a variety of birds rule the treetops. It was here that the machine-less Mayan people built their greatest city. As we were about an hour-and-a-half away by Rover across a raw limestone road, Andy and I decided to explore these ruins for a day.

Along the way, Andy and I gave a lift to a few natives (descendants of the original Mayans!), and dropped them off at their homes (huts, actually) along the road. As the jungle became thicker, we saw fewer and then no people. When we reached Tikal, we cleared a vehicle checkpoint and from that point on, we saw no one save for a solitary soldier-guard. What a difference between Tikal and Teotihuacan in Mexico, where the Pyramids of the Sun and Moon are crawling with tourists and defaced by vandals!

The size of Tikal is staggering. Within a little over six square miles, there are about three thousand structures. Particularly impressive are its six temple-pyramids, veritable sky-scrapers among buildings of their type. From the level of the Plaza floor to the top of its roof combs, Temple IV, the mightiest of them all, measures 229 feet in height. The core of Tikal is its Great Plaza, flanked on the west and east by two of these temple-pyramids, and on the north by a sort of acropolis. Some of the major architectural groups are connected to the Great Plaza and with each other by broad causeways, over which many splendid processions must have passed in the days of Tikal's glory.

Tikal is best known for the number of its monuments. Thus far, 83 stele and 54 altars have been found. The city has the finest wood-carvings known in the entire Mayan world - twelve doorways and lintels carved on the almost indestructible sapodilla wood. There are ten reservoirs at Tikal from which the Mayans obtained their drinking water. Burials of great richness have been uncovered beneath Tikal. Among the most striking is the "Painted Tomb" chamber underlying a temple facing the Great Plaza. There were three interments here, two of them adolescent victims sacrificed to accompany the principal personage, and a headless, handless corpse presumably recovered by his followers from the scene of a military disaster. Often found in these graves, by the way, are stingray barbs. These were used for blood sacrifices. Although Tikal is many miles from the sea, the ancient Mayans had well-established trade routes connecting coastal with jungle cities.

The thought of the organization and manpower required to build a city such as Tikal, right in the heart of the jungle, staggers the imagination. Andy and I explored and climbed temples and pyramids for hours upon end. It was so breathtaking that we actually said little to each other. In the still of the jungle, enveloped in a great limestone city that once was the pride of a great people, what could we say?

We had finished our canteen of water in Tikal, and replenished it at the vehicle checkpoint before we left for Flores. We had taken about 200 pictures between us, with no tourists to spoil our compositions. The day had been hot but the jungle itself was cool and shaded. It was a very beautiful jungle, the best I have ever seen, as its floor was relatively free of brush and covered with a pleasant leaf compost. If you overlooked the jaguars and snakes, it would be a perfect spot for a picnic!

When we returned to Flores, the Rover was a mess. It was filled with chalk dust and had to be hosed down. Andy and I took a dip in Lake Peten to take care of our chalk dust. While we had been in Tikal, Russ and Ross managed to spear a few large cichlids (which we promptly preserved). Our plans now were to return to Belize, stopping to collect in earnest at every likely prospect we had mapped on our way out.

In Quest of the Mayans – Part IV

[The Aquarium, March 1971]

Our night's sleep was disturbed by that ornery rooster once again. The crowing was so loud that Andy doubted that anyone back home would believe it so he tape-recorded the noise. At 5:30 am it was no use in trying to sleep any more. As Russ and Ross had laughed when we had told them of our rooster problems (their room was on the other side of the hotel so they couldn't hear the varmint!), we decided to teach them a good lesson. Accordingly, we sneaked into their room with the tape recorder, turned the volume up full, placed the machine near Ross' ear, and turned it on. The confusion and panic was immediate. Ross hot four feet straight up into the air, Russ only slightly less. We had made our point!

After breakfast and paying our bill, we were on the road at 6:45 AM. Our first stop was the Arroyo Ixlu, 29 miles east of Flores, where we had some really fine fishing. The creek stank from raw sewage (it was located alongside of several native huts, and quite obviously served as their cesspool!), but there were plenty of fish in it due to the fact that the water was flowing somewhat. Water lilies grew profusely, as did a sort of *Cabomba*-like plant. The bottom was mostly muck (there was rock in some places), but we put the seines to good use nevertheless. The catch consisted of the usual cichlid-livebearer-characin triumvirate, but the prize was a 6-inch long molly with blackish tail and electric-blue body. We caught one deformed adult but many young, however. This is really one of the "tricks" in fieldwork - to go for the young rather than for the adults. They ship better and more of them can be brought hack. It takes willpower, however, to leave such gorgeous show-quality specimens behind!

The only adult of this brilliant blue molly we caught was this deformed specimen. We did obtain, however, many young in perfect condition.

Our next stop was the Laguna Salpeten, a small lake almost touching the eastern boundary of Lake Peten. We weren't successful here as the water was muddy (I sank to my waist in stinking muck), and the presence of tree stumps snagged our seine time and time again. Some hobbyists think that collecting in the wild is "romantic." The truth of the matter is that it is hard, sweaty work, fraught with numerous hazards. The real thrill of collecting is when that seine is brought up. Will it contain new fishes? There is another aspect of collecting, also. For example, I don't particularly go much for mollies or swordtails (Joanne Norton, forgive me!), but it gives me a thrill to catch them in the wild. Don't ask me to explain it - I can't.

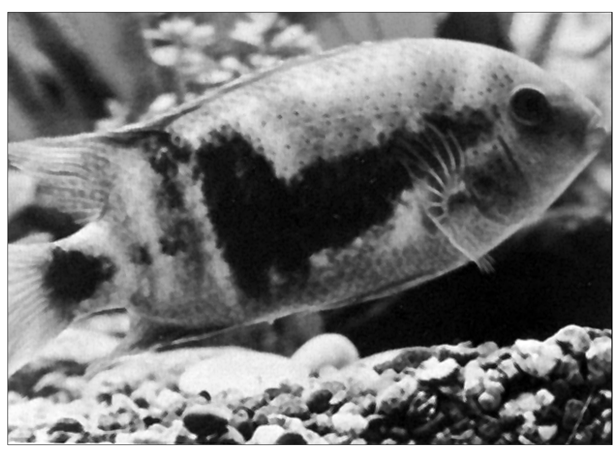
Ross Socolof (in shorts) and Russ Norris, sorting specimens at Arroyo Ixlu.

The next stop also was a lake, the Laguna de Macanche, alongside of which was a native village. Here we were luckier and caught some cichlids and a *Gambusia*-like characin. Right by the shore stood a tree bearing a strange-looking fruit resembling small, prickly surfaced golf balls. Russ became ecstatic and told us that when he was younger, the fruit was a real delicacy. Trusting Russ, we each popped one of the ping-pong sized fruits into our mouths. Promptly, we puckered up. They were the worst things we had ever eaten! Only after Russ himself tried one with similar results did he venture that he had made a mistake. They weren't quite the same fruit he knew as a child! We each needed a cerveza to work the taste from our palates.

We took a very poor, hilly dirt road that went north for about 6 miles, finally arriving at the Laguna de Yaxja, a fairly large lake one-quarter the size of Lake Peten. The water, however, was shallow, tepid, and utterly devoid of fish as far as we could determine. It did afford an opportunity for a swim, and this we took. The area was a rock-hunter's paradise; rough agate was everywhere, free for the taking. Butterflies abounded, and large century plants grew all around. Some of these plants were 6 feet high and 10 feet across (the only ones I ever saw in the States were small affairs in flowerpots). We spent a half-hour stroking the leaves and watching them fold before our eyes. Great sport, those century plants!

Then, out of nowhere, came a tremendous noise. Suddenly the sky darkened and we were in a "storm" of bees of some sort. This time we came close to panic for it was the kind of situation reminiscent of Alfred Hitchcock's film, "The Birds." We had no idea whether they were dangerous, so we dove into the Land Rover and buttoned up. The bee cloud passed a few feet over our heads and disappeared across the lake. We all sighed with relief!

After returning to the main road, we made our way to the border with no further stops. We got through Guatemalan customs all right, but ran into some difficulty on the British Honduras side where the agent slapped a 271/2% tariff on some Guatemalan fabrics Ross and I had bought in Flores. The fact that we planned to take them out of British Honduras upon our return home didn't help, and the agent suggested that we place them in bond with him. He would see that they were returned to us at the airport in Belize upon our departure. Knowing the foul-ups that could occur with that sort of arrangement, we paid the 27-1/2% then and there. It was worth it to us because as a consequence of arguing over the tariff, they



***Cichlasoma intermedium*, a species we found frequently during our travels.**

***Cichlasoma trimaculatum* (?), another often encountered species.**

neglected to search the Rover. Had they done so and found the fish we might really have had a bad time. Customs agents are seldom sure about what to do with aquarium fishes.

Once in British Honduras, we stopped in Benque Viejo to effect a partial change of water for the live specimens. Changing the water in bags is a little tricky at times, but it was accomplished without incident. However, the spines of several large cichlids we had pickled in Flores had pierced the bag of formalin they were in, and the rear of the Rover reeked with the fumes. This matter had to be attended to, and the formalin washed off where it had spilled.

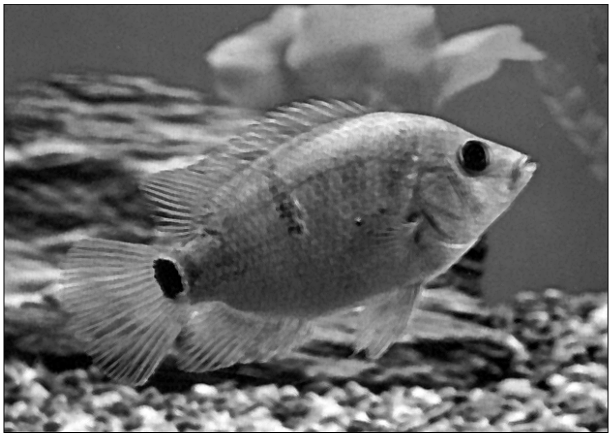
We stopped in Cayo for lunch and a swim in the Belize River. I really enjoyed this. The current was strong, and after swimming upstream (quite a tussle!), I would let the current carry me down again. During this time I smoked a cigar (I wasn't about to throw away a half-smoked 26-center!), and Andy was amazed that I could keep the darn thing dry. We spotted *Cichlasoma intermedium* and *C. trimaculatum* in the river, as well as *Petenia splendida*.

Our last stop before Belize City was at the ranch of Russ' folks where he wanted to check on a concrete well in which he had stocked some mollies. The well was dry, however, and so the experiment had come to grief. I managed to get a laugh as Ross stepped on one cow spur after another, the spines easily piercing his tennis shoes. While he jumped up and down in pain, I avoided trouble by more or less following in his footsteps and avoiding the "bad" ones. As I recall, he made some rather uncouth remark about what was funny and what was not.

After arriving in Belize City, we stopped at Russ' house and transferred the fish. The day was topped off with a swim, a few cervezas, and a dinner at our hotel. As far as the Guatemalan part of our trip was concerned, it had been an unqualified success.

Russ met us the following day in his VW bus and off we went to the private airport in the Northwest portion of the city, located right on the Caribbean. Charles Nord had agreed to lend us his single-engine, four-seater Beechcraft for the next two days. Our destination this morning was the southern coast of British Honduras, in particular a town called Punta Gorda (the "fat point"). Russ checked out the plane painstakingly, and off we went. Because of the limited payload and the fact that water is heavy (over 8 pounds to the gallon, over 7 gallons to the cubic foot), we traveled light and left a good deal of our personal gear back at the hotel. It was considerably better flying, however, than going by Land Rover.

We crossed Stann Creek, and then followed the coast past Mango Creek and Monkey River to Punta Gorda. To our right were the Maya Mountains; underneath, mostly jungle. We put down smoothly at 9:15 AM, and Russ and I hitched a ride in a delightful vehicle known as a "minibus," into the center of town. These junior-sized jeeps (which ride about 6 inches from the road!) are quite popular in British Honduras. Our mission was to secure transportation for ourselves and our gear into the interior. The owner of the local emporium, Mr. C.



***Cichlasoma urophthalmus*, a Guatemalan specimen.**

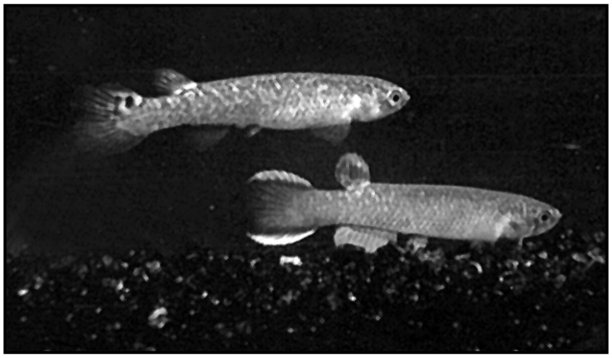
A. Johnson, agreed to chauffeur us in his old Chevy pickup truck, and we returned to the landing strip to pick up the others. Here Ross earned the title, "Tactician of the Year," as his bargaining with Mr. Johnson nearly set back US-British Honduras relations by some 10years. It was simply a matter of a communication gap, however, and everything was settled amicably.

Driving westward, we searched for one of Russ' contacts but to no avail. Twenty-six miles into the jungle, we seined our first creek, catching some *Astyanax* and several other characins (these fishes will be discussed in a sequel to this series by Dr. J. Gery). Our next stop was a real find, however. Ross and Russ were the first in, and Ross announced that he had caught some kind of *Rivulus*, I nearly dove in headfirst. Poor Ross! I grabbed his hand net and nearly shoved him a hundred feet downstream. If there is one type of fish that really "rings my chimes," it is *Rivulus*!

The fish were located along the banks (overgrown with *Philodendron*) in about 6 inches of water. Along with the *Rivulus* were some green swordtails. When I made a low swipe with the net, low enough to pick up mud, I obtained mostly swordtails. When I scooped the top 2 inches of water, mostly *Rivulus* were caught. Thus these two fishes occupied their own ecological niche, just a few inches from each other! It was interesting to note that although these *Rivulus* and swordtails (plus some freshwater shrimp) were present, no cichlids were found in this particular stream. In British Honduras, it is decidedly unusual not to find cichlids if other fishes are present. Perhaps this is why we found the *Rivulus*; they would have been eaten by the customary cichlids had they been present.

The killies turned out to be *Rivulus tenuis*, and therein lies a tale. Towards the end of 1965, several members of the British Killifish Association secured a new *Rivulus* (reportedly from an exporter in Hong Kong!), termed *Rivulus "achille*" by the British trade. Specimens of the fish were sent to the British Museum. Their examination, however, was inconclusive and they remarked only that the fish "resembled" *Rivulus punctatus*. Other specimens were sent to Col. J. J. Scheel who suggested that the fish best agreed with *Rivulus urophthalmus*. In February 1966, the late Ted Seymour sent me live specimens of *Rivulus "achille*," and I had no trouble in identifying them as *Rivulus tenuis*, a fish from southern Mexico (synonym = *Rivulus hendrichsi*). I ventured the thought that the Spanish pronunciation of "El Killie" is very close to "achille," and that this might be the origin of the popular

The author (closest to the plane), with Ross Socolof (middle) and Russ Norris, at the Punta Gorda strip.



***Rivulus tenuis*, sometimes known as "Stoke's *Rivulus*" or *Rivulus "achille*".**

name, although I knew of no exporters of fishes from southern Mexico.

The discovery of *Rivulus "achille*" in British Honduras points up once again an instance where Col. Scheel has misled aquarists in general, and killifish fanciers in particular. Apparently he is at it again of late, by "instructing" hobbyists that *Aphyosemion nigerianum* is really *Aphyosemion gardneri*. H. Stenholt Clausen, the well-known Danish zoologist who originally described the former species, disagrees. The damage is done, however, and many aquarists are referring to A. *nigerianum* as "*A. gardneri*," adding to an already confusing killifish nomenclature picture as it is.

Flushed with the discovery of *Rivulus tenuis*, the only killie caught during our trip, I almost failed to appreciate the value of our next (and final for Punta Gorda) creek that was a cichlid goldmine of the first order. No growing plants were found in the water, but the water contained much submerged vegetation and brush. The bottom was essentially soil. Here we caught *Cichlasoma intermedium* and three more cichlids we had never seen before! Ross captured almost a whole spawn of *C. intermedium*, and we all went wild seining one mass of cichlids after another. In addition to these, we found a new (to us) form of molly, wild green swordtails with red spots, three types of freshwater clams, and numerous cornucopia snails. Also found were the ubiquitous *Astyanax* characins and *Belonesox*.

Happily we sped back to the airstrip with our precious burdens, and loaded the plane for the return flight. We bid goodbye to Mr. Johnson, and a host of native boys who were fascinated by our aircraft, and took off for Belize City. An hour later we made a perfect landing at Belize, and after settling the fish in Russ' house (except for the Rivulus which I refused to let out of my sight!), we returned to discuss the day's events. Tomorrow we would be off in search of a rumored, fabulous red cichlid. Was it myth or fact? The morrow would tell us.

In Quest of the Mayans – Part V

[The Aquarium, April 1971]

A fabulous red cichlid! Or so the legend went. As Russ told the story, each of us in our own way discounted it. For one thing, although red cichlids are known from Costa Rica there was nothing in the scientific literature to suggest that such a fish was ever observed in British Honduras. Certainly the "Red Devil" of Costa Rica was not native to British Honduras. So, what could it be? Secondly, the source of the tale was a native fisherman. Perhaps he simply concocted the story as fishermen are won't to do. Even if a red fish existed, it most likely would turn out to be only a slightly reddish specimen of no earthly interest to anyone. But we had been on wild chases before; one more wouldn't hurt! Thus it was that the next day we were up a 5:30 am, ready for our flight to Hill Bank.

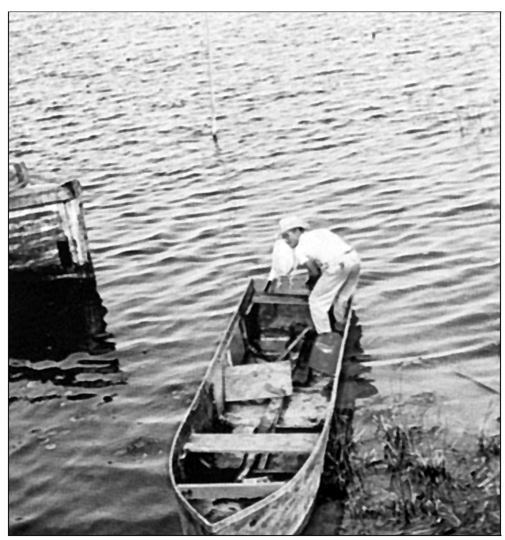
Hill Bank is a logging camp situated at the southern end of the Laguna de Hill Bank, a long (15 miles), narrow (1 mile wide), lake located about 30 miles northwest of Belize City. It empties into the Rio Nuevo which discharges into the Caribbean at Corozal in the northeastern tip of British Honduras. This whole area is a massive swamp containing excellent stands of mahogany. The logs are felled

The Laguna de Hill Bank, home of the red bay snook, British Honduras.

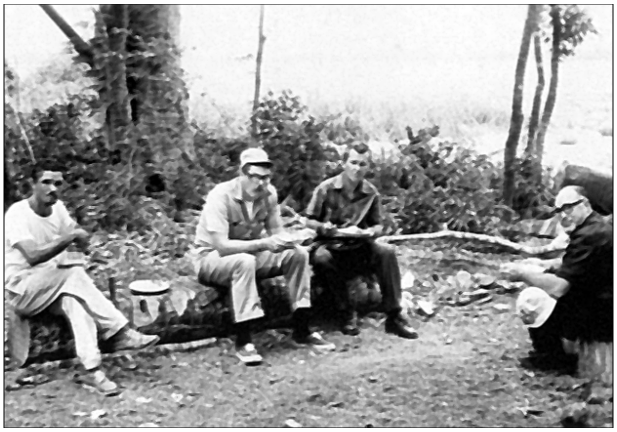
and dragged to the lake where they are chained together for the long journey down the Rio Nuevo to the coast. We took off at 7:45 AM and 20 minutes later we were over the lake. Near the northern end, Russ banked the plane and "buzzed" the treetops. The day before he had contacted his native friend via short-wave radio, and the buzzing was to let him know we had arrived. There was no place to land here so we turned south for Hill Bank proper. Russ set us down hard this time, so he had to endure about 10 minutes of wisecracks while we all put our teeth back in place. We had expected a long wait before Russ' friend showed at the wharf, but he arrived almost as soon as we arrived. It seems that he had started some two hours ago from the logging camp we had just buzzed! Such are the advantages of air travel provided, of course, one can find a place to land. That's always the problem in the jungle.

Rudolph was his name, and he turned out to be a warm, intelligent chap who quickly convinced us that the story of the red cichlid was no pipe dream. Unfortunately, at this time of year (the dry season) the fish were to be found only at the northern end of the lake, a good three hours by his sheet-metal canoe powered with a very small outboard motor. This rough vessel was a bit short on seats, so most of us sat on various pieces of equipment that, for some reason, seemed to feature nothing but sharp points.

The trip north was a long, hot journey. We had not made any arrangements for provisions as we had all agreed to travel "light" because of the restricted plane capacity. This, unfortunately, included water as well. The heat increased our thirst to a point where it was almost unbearable, ironically so as we were in the middle of all that water. We were worried about the potability of the lake water, however. The banks were fetid and it did not seem as if the lake was subject to the flushing that purifies natural bodies of water, at least not during the dry season. Russ was the first to toss in the sponge and he scooped up some water in his facemask, and we followed suit. As it is now 6 months later, evidently we had nothing to worry about although I was somewhat shaken three months ago when, attending the 10th Congreso Internacional de Micobiologia in Mexico City, I learned that both British Honduras and Guatemala were hit by a particularly virulent form of dysentery (not respondent to the usual antibiotics) with a mortality rate of 10% during the time we were there!



Rudolph and the sheet metal boat in which we traveled 6 hours to find the red cichlid.



Ross Socolof (holding the blue hat), Russ Norris, Al Klee (who looks as if he just swallowed a large jungle rat — which he did!), and Rudolph, our guide, lunching at a small logging camp on the Laguna de Hill Bank.

Our first stop was Rudolph's logging camp where we met his companeros who offered us lunch consisting of rice and "gibnot." Gibnot is a local rodent, somewhere in size between a pacu and a capybara. It tasted great, however, and we were thankful for the meal. It was especially appreciated when we realized that these natives were really short on food and were sacrificing when they offered to share their meal with us.

We watched two of them work on a log, making a dugout canoe. The log was about 3½ feet in diameter, and 14 feet long. These two men were working with nothing more than axes, each taking turns of about 15 minutes. In that heat, none of us would have lasted 10 strokes! We were told that the job would take three days and that the finished canoe would be worth $30. This worked out to $5 per man per day of the hardest sort of work imaginable. I nearly fell off the tree stump I was sitting on when I learned that the older of the two was well into his sixties! I think we Americans are a soft lot, and not really appreciative of how well off we are.

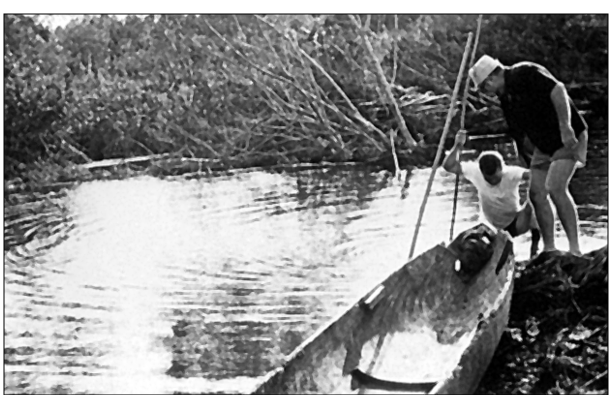
We did do some fishing at the camp, spearing a few mollies (brassy yellow bodies with blue-black tails). Also present were several cichlids (which we could neither identify nor spear), Astyanax, Rhamdia catfish, and Gambusia. It was time, however, to travel the additional hour to get to the northern end of the lake.
The end of the lake degenerated into a shallow inlet, thick with strands of a Sagittaria-like plant perhaps 4 feet long, and lily pads 10 inches across. We saw scores of a brilliantly colored fish sporting deep reds and electric blues, and then - it happened! A red flash darted alongside the boat. Rudolph had not exaggerated. The fish was a deep, velvety red, and all red at that.

In a few minutes, everyone except Rudolph was in the water, Russ and Ross with face masks and spears about 10 feet long, Andy and Ito get a better perspective for our camera shots. Russ speared one of the red-blue beauties we had seen earlier, a fish that later turned out to be Cichlasoma synspilum. This species has a scarlet breast, and deep blue dorsum and fins. Certainly this species alone was worth the trip to Hill Bank. It is one of the most beautiful cichlids I have ever seen. However, the red cichlids were there, too! In all we saw about 30 of them but were unable to catch any (the water was too deep for seining). They were seen in sizes up to 10 or 12 inches, a solid red

The old man swinging this axe is well into his sixties! A dugout canoe such as this one takes three back-breaking days for two men.

color, and looking much like the all-red Japanese higoi. Apparently they were sports of Petenia splendida, and which Rudolph referred to as the "red bay snook." In addition we also saw two specimens of this fish of a whitish-gold coloration. This was an exciting find, and we realized that it represented a major discovery to the ichthyological world. Unfortunately, time was running out and we still had three hours of water travel before we could reach our plane. We had to be in the air by 5:00 PM because it is illegal to fly in British Honduras after 5:30 PM (there are no night landing facilities in the country), so reluctantly we packed our gear. Nevertheless, we had found the fabulous red cichlid!

On our way back I noticed that Rudolph had another small outboard motor stashed away in his boat, and suggested that we use both. This Rudolph did but now the boat was overpowered and, in conjunction with small storm that hit the lake about this time, we shipped a great deal of water on the way (the storm didn't produce much rain, but it did bring much wind and consequently, the waves were quite pronounced). The waves hit everyone and we were all drenched. We made it back to Hill Bank and lugged our gear up to the plane, taking off just about 5:00 PM but not before thanking Rudolph for one of our best experiences of our whole trip. We landed at Belize City just before "curfew", this time Russ making a perfect landing which redeemed his early 1-point stab at Hill Bank!



Ross Socolof and Russ Norris, trying to spear the red cichlid.

Ross, Andy, Russ, and I spent half the night talking about the red cichlid. Andy thought that he had obtained some surface shots of the fish while it skimmed by (my camera had given up the ghost, breaking its film advance gear assembly), but if not we wondered if anyone would believe us. The next day was our planned departure day, so we could not return to the Lake this trip. We topped off the evening, however, with a tremendous Mexican-style dinner given in our honor by Russ and Dalila Norris in their home. It was a happy culmination to a fantastic day.

The next morning found us spending several hours getting the fish packed for air travel. We really needed Russ' VW bus to move us to the airport! Before we took our leave, we discussed with Russ plans for him to return to Hill Bank, and he agreed to try (via an overland trip) within two weeks. This he did accomplish, and Russ' own account is given as a sequel to this series. Thus, no more will be said about the fabulous red cichlid at this point. We had had one of the finest collecting expeditions either Ross or I had ever experienced, but even better we had established firm friendships, primary among them being Russ and Dalila Norris. Thus it is that the aquarium hobby is more that just that. The fish, the collecting, the people involved - all combine to produce memories that will be with us for many years.

A Guide to the Pronunciation of Scientific Names

[The Aquarium, January 1971]

The title of this brief exposition claims no more than "guide" because it is, unfortunately, a subject of considerable dilatancy. (A dilatant liquid, for example, is one that, the more you stir it, the harder it becomes to stir — a sort of "silly putty") For one thing, there are no official "Rules" as exist for the naming of things (as, for example, the International Rules of Zoological Nomenclature). Thus, zoologists are not constrained to subscribe to a single standard in the matter of the pronunciation of the names of either fishes or plants. It is somewhat comforting to note, however, that a system does exist that at least is used by a majority of professionals both in this country and in England. This is the so-called "English method" which, briefly stated, gives the sounds of words their customary English sounds and employs the usual rules of Latin accentuation.

The English method goes back to the period when the method was used in English Courts of Law. Following this, it was widely used throughout English and American schools. A fly in the ointment, however, is that recently it has been superseded by the "Continental method," now used exclusively in the secondary schools and colleges of the United States and many parts of Europe. To illustrate the difference, compare the pronunciation of the word bivittatum, part of the name of a well-known killie:

English method: BYE-VEH-**TAY'**-TUM
Continental method: BIV-VEH-**TAH'**-TUM

Since in zoology the English method is the more usually encountered, it accordingly forms the basis for the substance of the following discussion. It is a simple solution for aquarists who, in the main, do not wish to become Greek or Latin scholars or to become embroiled in pedantic hair-splitting.

To bring order out of chaos, let us separate two distinct considerations in pronunciation — enunciation and accent — and tackle enunciation first. In general, all accented vowels are long with the exception of a vowel that is followed by two consonants. For example, brachy is pronounced **BRAK'**-EE since the A is followed by C and H, both consonants. On the other hand, *Labeo* is pronounced **LAY'**-BEE-OH since the A is followed by the single consonant, B. This rather straightforward and simple rule settles the question of whether it is TIL-**LAY'**-PEE-AH or TIL-**LAP'**-EE-AH for *Tilapia*. The former is "right on." In accordance with this rule, I would disagree with authorities who pronounce *nigrofasciatus*, NYE-GRO-FASS-EE-**AY'**-TUS. The first I is not the primary accent and it is followed by a double consonant. Pronounce it, NIH-GRO-FAS-SEE-**AY'**-TUS. It is not, by the way, necessary to pronounce all of the vowels in a word fully and roundly. To do so would sound ridiculous and pedantic. We now consider some additional rules to aid in enunciation. To simplify matters, we have noted only the primary accent in the examples.

Rule 1. When a fish is named in honor of a person (this is called a "patronym"), the name should be pronounced as the owner would pronounce it. Pronounced otherwise, the connection between man and plant or fish is almost entirely obliterated, and one of the chief purposes of giving the name is defeated.

Examples:
(a) *arnoldi*, **AR'**-NOLD-EYE
(b) *dayi*, **DAY'**-EYE
(c) *viehoeveri*, VEE-**HOO'**-VER-EYE
(d) *riddlei*, **RID'**-DEL-EYE

Most hobbyist errors in pronunciation can be traced to this source. Two frequent (and horrible!) errors are as follows:

Name	Incorrect	Correct
agassizi	AG-GA-*SEE'*-ZEE	**AG'**-AH-SEE-EYE
ramirezi	RAM-AH-**REE'**-ZEE	RA-**MEER'**-IZ-EYE

Although this rule does justice to the person being honored, it is sometimes difficult to follow, and numerous examples could be cited. Levine, for example, may pronounce his name

LEH-**VEEN'** or he may pronounce it LEH-**VINE'**, and aquarists may not have any way of knowing which is correct. An example of a trap the author himself fell into concerns the pronunciation of the killie, *Rivulus milesi*. It would seem reasonable to most aquarists that the trivial portion of the name should be pronounced, *MILES'*-EYE. Captain Miles, however, was a Latin American, and the correct pronunciation is **MEE'**-LES-EYE. These are really minor difficulties, and things would be vastly improved merely if aquarists would make an attempt to pronounce patronyms in good faith. If Messrs. Levine and Miles happen to have names with unexpected pronunciations, at least you have tried!

In the days of the old Rules of Nomenclature, a double-i ending for patronyms was common. Thus we have *Rivulus hartii*, for example. (Contrary to some authorities, it is not correct under the new Rules to drop the second I. If the name is valid, the second I must stand.) In such cases, the first I is pronounced, EE, the second, EYE.

Examples:
(a) *blockii*, **BLOCK'**-EE-EYE
(b) *playfairii*, PLAY-**FAIR'**-EE-EYE

Rule 2. In words beginning with CT, PT, or PS, the first letter is silent. Examples:
(a) *Pterophyllum*, TER-OH-**FILL'**-LUM
(b) *Ctenobrycon*, TEN-OH-**BRY'**-CON
(c) *Pseudocorynopoma*, SOO-DO-KOR-RIN-NO-**POE'**-MA
(d) *Ctenops*, **TEN'**-OPS

Notice the use of double consonant rule in the pronunciation of *Pterophyllum* (it is not TER-OH-**FYE'**-LUM).

Rule 3. CH is always pronounced hard.
Examples:
(a) *Charax*, **KAY'**-RAX
(b) Characin, **KAR'**-AH-SIN
(c) *Chela*, **KEE'**-LA
(d) *Chaetodon*, **KEE'**-TO-DUN

Characin is frequently mispronounced, **CHAIR'**-AH-SIN. Note that the soft A in the first syllable is an exception to the general accented long vowel rule as followed in **Charax**.
Rule 4. OE and AE in combination take the long sound of E. Examples:
(a) *Poecilia*, PEH-**SIL'**-EE-AH
(b) *Aequidens*, **EE'**-KWI-DENS
(c) Nandidae, **NAN'**-DA-DEE
(d) *marthae*, **MAR'**-THEE

Diphthongs are usually difficult for Americans. This rule should help in pronouncing the family names of fishes, as they end in IDAE. Note also the exceptions to the general accented long vowel rule in *Poecilia* and Nandidae. The stressed vowels are softened to facilitate pronunciation. To attempt to use the long vowels here would result in disaster, and would necessitate a lip contortionist!

Rule 5. G is sounded hard when it comes before A, 0, and U. It is sounded soft when it comes before E, I, and Y.
Examples:
(a) *Geophagus*, JEE-OH-**FAY'**-GUS
(b) *Gambusia*, GAM-**BEW'**-SEE-AH
(c) *Brachygobius*, BRAK-EE-**GO'**-BEE-US
(d) *Gymnotus*, JIM-**NO'**-TUS

This is usually handled correctly by aquarists as it follows a simple rule that is used in everyday speaking.

We turn now to the matter of accent. Fortunately for hobbyists, two-syllable words are always accented on the first syllable. The problem arises on polysyllabic words containing more than two syllables. In the discussion that follows, only the last accent is considered for, if this is correctly placed, the other accents generally will follow naturally and automatically. It is well to remember that the secondary accent almost never falls less than two syllables before the primary one. Thus, for *Corynopoma* (using “ for the secondary accent), it is pronounced, KO**-RIN”-**OH-**PO’**-MA, not **KO”-**REE-NO-**PO’**-MA; *Corydoras* would be pronounced **KO”-**REE-**DOOR’**-AS, however.

As a general rule, the accent is placed upon the next-to-the-last syllable, called the “penult,” when that syllable is long.

Examples:

(a) *Cichlasoma*, SICK-LA-**SO’**-MA

(b) *Hyphessobrycon*, HY-FESS-OH-**BRY’**-CON

(c) *semifasciolatus*, SEM-EE-FAS-SEE-OH-**LAY’**-TUS

(d) *oligolepis*, OH-LEE-GO-**LEE’**-PIS

Common errors for (b) and (d) are OH-LEE-**GOL’**-LA-PIS and HY-FES-**SOB’**-RA-CON, respectively. There is a tendency today to move the accent farther forward (to the left) in a word, e.g., the two examples just noted, JEE-**OF’**-AH-GUS (for *Geophagus*) and AH-**NACK’**-ER-RIS (for *Anacharis*). This, of course, destroys the old syllables and creates new ones. As this is an affectation quite illogical in that the etymology of the word is destroyed, we stress that illegitimate syllables should not be created by shifting accent. The last two examples should be pronounced, therefore, JEE-OH-**FAY’**-GUS and AH-NA-**KAY’**-RIS, respectively.

The problem with the “general” rule, however, is that aquarists have little idea when the penult is long. As the rules for this are somewhat complicated, it is best to consider the problem by means of examples. If a word is not accented on the penult, it will always be accented on syllable before the penult, called the antepenult (i.e., the third syllable from the right). Here, therefore, are the more important ending that genera take the stress on the antepenult.

(1) Words ending in ODON or ODONT.
Examples:

(a) *Pantodon*, **PAN’**-TO-DON

(b) Cyprinodont, SEH-**PRIN’**-OH-DONT

(c) *Symphysodon*, SIM-**FYE’**-SO-DON

(2) Words ending in EUS or EUM.
Examples

(a) *Chalceus*, **KAL’**-SE-US

(b) *Myleus*, **MY’**-LE-US

(c) *coeruleum*, SEE-**ROO’**-LEE-UM

(3) Words ending in IDAE.
Examples:

(a) Cichlidae, **SICK’**-LEH-DEE

(b) Poeciliidae, PEE-SIL-**EYE’**-EH-DEE

(4) Words ending in IA or IAS.
Examples:

(a) *lalia*, **LAL’**-LE-AH

(b) *Tilapia*, TIL-**LAY’**-PEE-AH

(c) *Neolebias*, NEH-OH-**LEE’**-BE-AS

(d) *Botia*, **BOAT’**-E-AH

(5) Words ending in STOMUS.
Examples:

(a) *Hypostomus*, HY-**PO’**-STO-MUS

(b) *Nannostomus*, NAN-**NO’**-STO-MUS

(6) Words ending in ION, I0 or EO.
Examples:

(a) *Aphyosemion*, AF-FEE-OH-**SEE’**-ME-ON

(b) *terio*, **TER’**-EE-OH

(c) *Labeo*, **LAY’**-BE-OH

(7) Words ending in IUS and IUM.
Examples:

(a) Characidium, KAR-AH-**SID’**-DE-UM

(b) *conchonius*, KON-**KO’**-NE-US

(8) Words ending in a consonant plus S.
Examples:

(a) *latifrons*, **LAY’**-TA-FRONS

(b) *acuticeps*, AK-**KEW’**-TA-SEPS

(c) *elegans*, **EL’**-LE-GANS

(9) Words ending in PTERUS, PTERA or PTERIS.
Examples:
(a) *Notopterus*, NO-**TOP'**-TE-RIS
(b) *callipteris*, KAL-**LIP'**-TE-RIS
(c) *Ceratopteris*, SER-AH-**TOP'**-TE-RIS
(d) *dolichoptera*, DO-LA-**KOP'**-TE-RA
(10) Words ending in CEPHALUS or CEPHALA.
Examples:
(a) *microcephala*, MY-KROW-**SEF'**-AH-LA

(11) Words ending in CUS.
Examples:
(a) *typicus*, **TIP'**-AH-CUS
(b) *metallicus*, MET-**TAL'**-LAH-CUS
(c) *electricus*, EL-**LEK'**-TREH-CUS

(12) Words ending in LUS if not preceded by I or L. (But see No. 10.) Examples: (a) Fundulus, FUN'-DU-LUS
(b) Rivulus, RIV'-YOU-LUS
(c) Monodactylus, MOE-NO-DAK'-TEH-LUS

(13) Words ending in ERA or ARA.
Examples:
(a) *velifera*, VEH-**LIF'**-EH-RAH
(b) *vivipara*, VEH-**VIP'**-AH-RAH
(c) *filigera*, FIL-**LIDGE'**-EH-RAH

About 40% of fish names are accented on the antepenultimate syllable; therefore it does pay to study the above examples. There are exceptions to these examples, but generally they will hold.

In summary, the hobbyist ought to remember three things:
(1) In using patronyms, try to pronounce the name to sound 's near to the original as possible.
(2) Avoid destroying original syllables by moving the accent forward.
(3) If you mispronounce a name, don't worry about it. Pronunciation is not what the hobby is all about!

A History of the American Killifish Association

[The Aquarium, January 1971]

Author's Note: The date of our meeting cited in the original article (August 1961) was in error; I have corrected it to June 1961. The actual date was June 134, 1961. *AJK.*

It would, in my view, be wrong to dismiss this brief chronicle of the American Killifish Association simply on the grounds that one is not particularly interested in killifishes. The fact of the matter is that the AKA has been the most successful aquarium organization in the history of the hobby anywhere in the world, bar none. It is, therefore, relevant to any aquarist interested in hobby organizations, how they get started, what makes them tick, and how they prosper. It is primarily for these reasons that this history is now put to paper.

The AKA was not the first serious attempt to formulate a killifish organization of at least national scope. Several years prior to the launching of the AKA, a proposal was made by Alan Fletcher, then Technical Editor of the old AQUARIUM magazine, that an "American Panchax Association" be formed. Although not a killie authority himself, he had observed the keen interest in these fishes and recognized the value of such an organization to the hobby. The suggestion, however, elicited little tangible response from aquarists. In a sense, this is commonly the experience of many club bulletin editors who plead in print for articles. The response is generally nil, and some editors find that only direct, face-to-face requests for specific material are fruitful. Fletcher, however, did approach two well-known killifish authorities but unfortunately, although these two hobbyists possessed the requisite technical killifish knowledge, they either did not have sufficient organizational ability or lacked the spirit to cope with organizational details, admittedly not always an exciting assignment.

Thus we come to another dictum in hobby organization: it is not always the "expert" who is the most effective organizer. Yet, regardless of organizing ability, the man with the reputation or the "title" is almost automatically chosen to lead. In any event, thus died the "American Panchax Association," stillborn.

In June of 1961, the author's telephone rang: "Hello! I'm Bob Criger. I'm interested in killifishes and wonder if we couldn't get together tonight for dinner?" With this telephone call, in effect the American Killifish Association was born. Bob, who was visiting his home offices of the Armco Steel Corporation in Middletown, Ohio (some 20 miles from where I lived), projected such bright enthusiasm over the phone that I accepted the invitation and drove to meet him.

Robert O. Criger turned out to be a tall, friendly, personable fellow, lately interested in killies. It turned out that his telephone call to me was triggered by a series of articles I had authored for the old AQUARIUM JOURNAL (see Klee, Albert J., "A Fresh Look At The Genus *Aphyosemion*," AQUARIUM JOURNAL, August, September, and October 1960). This particular series was one in which I had invested a great deal of time and effort for at the time, little information was available with regard to these fishes. Today, I look back at some of the inadequacies of that particular material with some misgiving. We have all learned much about killies since then!

In any event, Bob had read the series with interest and, knowing that I lived in the area, took a chance, located my telephone number and called me out of the proverbial "clear, blue sky." He was prepared with a list of killie topics for discussion that could have formed the basis for a good-sized book. These were tackled with enthusiasm for in those days, finding persons that were devoted to killies just wasn't easy!

The conversation continued after dinner. We bemoaned the scarcity, not only of information about killies, but also of the scarcity of the fishes themselves (today's killifish fanciers are really spoiled by the relatively easy access of these fishes!). Sometime after midnight, Bob thought out aloud: "Wouldn't it be great if we had some sort of club devoted solely to killies?" At first I was reluctant, knowing full well the work involved and that ventures of this sort usually wound up with but a few people carrying the main load, ultimately to fail because of general apathy. Further, the experience of the ill-fated "American Panchax Association" was not unknown to me. However, Bob was particularly interested in developing a professionally produced publication strictly for killies, and as he had had considerable publishing experience and access to processes and printers, his suggestion became persuasive. Then, too, the challenge of developing a really successful national aquarium organization was appealing and ultimately irresistible.

By our fifth highball, we mutually agreed to attempt the formation of a national killifish association. It was decided that Bob would handle publicity, membership, and correspondence, and that he would simultaneously work out plans for a publication; to me fell the task of organization, planning, operations, and By-laws. On this note we parted, Bob returning to Kansas City, his home at that time.

One of the observations I had made regarding the failure of prior specialist's organizations (sundry national guppy and goldfish groups, and the International Federation of Aquarium Societies in particular) was that they seldom provided opportunities for practical but significant involvement on the part of the rank-and-file. Furthermore, I had observed that these so-called "national" efforts tended to become localized. Since not all hobbyists are affluent enough to attend meetings located far from their homes, the leadership of such organizations tended to concentrate in a limited number of geographic areas, with subsequent area domination. With Bob in Kansas City and me in Cincinnati, we already had a fair start of sorts on geographical dispersion. A search was then initiated for aquarists living in other areas who were able to contribute to, and interested enough to participate in, charter committee.

Our first invitation went to John Gonzales, then of Philadelphia. John is one of the real "old-timers" in the hobby. He was, for example, the first American aquarist to breed Rasbora maculata. A keener mind and superior breeder of killies could not be found. Due to a chronic back injury, John was forced to retire relatively early in life, but as he could not stand to be idle, he had decided to breed selected groups of fishes for the commercial market, i.e., those fishes requiring too much individual attention for commercial hatcheries to handle. Primary among the fishes he bred were killies.

In Chicago, we found two men with excellent qualifications. One was Charles Glut, an engineer who was gaining a reputation as an "innovator" in the killifish field. The other was George Maier, who possessed an enviable record of years of experience with aquarium fishes, particularly killies. At the time, George (who, with his wife, operated a fish store) was Advisory Editor of the now defunct TROPICALS MAGAZINE. George Maier, it might be mentioned, is a man for all occasions. His technical craftsmanship is flawless, and his warmth for people unsurpassed.

The next to be invited was Bruce Turner, of New York City. Bruce, then a student at Brooklyn University, lived, ate, and breathed killifishes (he later was to become a professional ichthyologist). He corresponded with collectors and professionals all over the world, and could rattle off the musty references to killifishes in the literature of a hundred years ago with the same facility the more typical teenager rattled off baseball averages. The last member of the Charter Committee was Bernard Halverson, a chemical engineer who had attained a national reputation when he persuaded the Houston Aquarium Society to sponsor the sale of dwarf white worms, then relatively unknown to the hobby. These men provided at least some of the geographical diversity we thought to be critical. It is somewhat ironic to note that we were not successful in obtaining West Coast representation on the Charter Committee. At the time, the killie fires were hottest in the East, and California fanciers were relatively unknown. How this has changed since then!

In order for a committee of seven people dispersed about the country to operate without chaos, some system of corresponding had to be devised. Thus, the Charter Committee served as an experimental vehicle in which to work out the modus operandi that basically was to be used by future Boards of Trustees of the AKA. John Gonzales was instrumental in suggesting the technique that finally proved workable. (Briefly, the chairman of the group sends his letter to the others about the first of the month; by the middle of the month the others send their letters, with copies to all. The function of the chairman is to summarize comments, formalize motions, assign motions a number and a place on the agenda, and to conduct and record the vote. Thus, regardless of where a participant resides, he shares involvement in policy-making equally with the others in the group. The chairman has no greater powers than his peers. He is an equal among co-equals, but traditionally acts to minimize discord and to expedite the flow of business. This approach serves to eliminate the one-man-show responsible for the many prior failures of national organizations.)

Many of the individual members of the Charter Committee, as might be expected, had particular interests in the structure of the Association. Charles Glut, for example, devoted much of his time to the concept of the "egg bank," a system whereby volunteer hobbyists would breed and maintain certain species of killifishes that might otherwise disappear from the hobby through neglect or lack of interest. (The internal debate over egg bank plans was, unfortunately, quite acrimonious.) Bruce Turner applied himself mainly to the organization's acquisition of new species; George Maier cultivated crucial support from aquarists in the important Chicago area; I occupied myself with the preparation of the By-laws. All of us, however, actively discussed and debated all aspects of the new organization.

During this time, Bob Criger, acting as publicity liaison officer, contacted all of the national aquarium magazines with a view towards publishing news of the proposed organization and keeping aquarists informed of the progress of the Charter Committee. All agreed to cooperate with the single exception of the TROPICAL FISH HOBBYIST. Although the AQUARIUM JOURNAL, TROPICALS, and AQUARIUM magazine published many progress reports and announcements regarding the AKA none ever appeared in TFH.

Aside from the egg bank controversy, a friendlier disagreement arose, concerned with the naming of the new organization. The two main proposals advanced were: American Killifish Association, and American Panchax Association. The problem with "Panchax", however, was that it was based upon a scientific name long since abandoned by the profession, and applied originally only to a very few fishes. The major objection to "Killifish" was the implication that these animals "killed" other fishes. Such logic, however, when applied to fishes such as "tiger" barbs, tricolor "sharks," etc., quickly produced a reductio ad absurdum, and the Charter Committee voted overwhelmingly to select American Killifish Association as the official name. (See the accompanying article, Why Not Panchax?" which presents additional details of the matter.) **Author's Note: This article did not appear until the April 1971 issue.** ***AJK***

The By-laws of the AKA contained several novel features. A seven-man Board of Trustees was devised as the policy-making force for the Association. For continuity, three were elected in odd-numbered years, four in even-numbered years, and all served two-year terms (an early amendment to the By-laws stipulated that Trustees had to take at least a one-year "vacation" before they could run again for office). Only members from the United States or Canada could vote or hold trusteeship office (foreigners were considered, of course, but the problems of conducting business via the mails among countries mitigated against it).

An important clause read: "… no more than two Trustees of the seven shall reside in the same State in the case of the United States, or in the same Province in the case of Canada". With one clause then, the new organization avoided the old problem of regionalizing or concentrating power in any one particular area, an occurrence that killed many a prior national aquarium organization. Perhaps even more important was Article VII, "Mode of Operations," which stated: "Insofar as it is applicable, the business of the Association shall be carried out by written correspondence." Thus, in the AKA, anyone could run for the Board of Trustees and expect to participate equally with other Trustees if elected. It was no longer necessary to be rich, retired, or both to fulfill one's obligations as a Trustee. One did not have to travel, say, from Alabama to California to vote at a national convention or in vis-à-vis committee. A $.06 stamp and a little time was all that was required. The By-laws were adopted unanimously by the Charter Committee.

At the beginning of 1962, prospective members sent in $5.00 for their first year's dues, voted for seven Trustees and their choice of fish for the club emblem. Fourteen aquarists were nominated for Trustee based upon recommendations received by the Charter Committee from interested aquarists during the latter part of 1961). In order that hobbyists would know whom they were voting for, bibliographic sketches were prepared by the candidates, edited into a standard format by the Charter Committee, and distributed to the voters. This is a commendable practice, still followed by the AKA. The choice of fish for the Association's emblem, by the way, was closely decided between the lyretail and the blue gularis, with the latter receiving the nod.

The details of the results of these first elections and the subsequent development of the AKA are to be found in the pages of the Association's publications (particularly KILLIE NOTES). As I do not want to unnecessarily burden the reader (especially non-killie fans!) with such details, they will not be discussed here. Several general comments, however, might be helpful to other national aquarium organizations, extant or proposed. From the start, the AKA's publication program was a resounding success. KILLIE NOTES (a professionally produced offset publication) came first. This was a mixture of topical club news and technical material. It was decided later to separate the two functions, and when the Association had sufficient funds, the publication was discontinued with two new ones taking its place: the AKA NEWSLETTER, and the JOURNAL OF THE AMERICAN KILLIFISH ASSOCIATION (JAKA).

Because the AKA depends so heavily upon the exchange of fishes and eggs among its members, a booklet entitled Killifish Exchanges was published soon afterwards. A host of other specialized publications appeared, the most important of which included a beginner's guide and the Killifish Index. In short, the publications activity of the AKA has been extraordinary — no other aquarium organization has ever matched it.

One of the most effective instruments for selling killifishes to the public and for recruiting new members proved to be the AKA's audiovisual (slide/tape) program. Sight and sound told the Association's story and the story of killifishes. It was loaned free of charge to responsible hobby organizations.

One of the really vital activities of the AKA was, and still is, its free (to members) egg and fish listings in its monthly newsletter. This enabled fanciers all over the world to obtain, exchange, and even sell many different species of killies. From a historical standpoint, however, two species of killies in particular spurred special interest in the hobby in the late 1950's and early 1960's. Indeed, they were partly responsible for the founding of the AKA in that they created general interest in the family. These species were *Aphyosemion filamentosum* and *Aphyosemion nigerianum*, the former because it was a new, reasonably sized and easily-bred "bottom spawner" (bottom spawners being relatively rare at the time); the latter also was an easily-bred fish but in addition, it was a brightly-colored and exciting new "top-spawner" introduction. The AKA should really erect a monument to these two species! Another species important to the early AKA was the blue gularis. It was a natural "salesman" for the AKA!

The AKA has come a long way since 1961, and it has since seen the participation of many hobbyists from all over the world. In a sense, the new killifish hobby is quite different from the old killifish hobby when I can remember paying $10 for a pair of *Aphyosemion bivittatum* in the days when $10 was equivalent to $20. The species available to hobbyists today would simply amaze the hobbyists of a generation ago! Those of us, however, who were privileged to assist in the formation of this great organization almost 10 years ago, will never forget those difficult but fascinating days of its birth; assuredly, we all treasure having had a chance to serve.

A Note on the Name of *Apistogramma ramirezi*

[The Aquarium, March 1971]

The last revision of fishes allied to the genera *Geophagus* and *Apistogramma* was made by C. Tate Regan in 1906[1]. These two genera (together with the genera *Retroculus* and *Biotoecus)* were distinguished from other genera of the family Cichlidae by simultaneous satisfaction of the following conditions: the presence of a dorsal fin unnotched between its spinous and soft portions; gill rakers, if present, of short or moderate length and in small or moderate number; anal fin with three spines; teeth conical; preoperculum entire; a compressed lobe on the upper part of the anterior branchial arch. The genus *Cichlasoma,* for example, also has gill rakers of short or moderate length and in small or moderate number, and it too lacks the notch between the spinous and soft portions of the dorsal fin; however, its species are characterized by the presence of more than three spines in the anal fin.

Of greater interest here, however, is Regan's key distinguishing between *Geophagus* and *Apistogramma* (the latter was described in Regan's 1906 paper as a new genus, *"Heterogramma";* this, however, is preoccupied by *Heterogramma* Guenee 1854):

D XII-XIX, 9-14; upper lateral line well separated from the spinous dorsal - G*eophagus.*

D XV-XVI, 5-7; upper lateral line, if complete, separated from the dorsal fin, for most of its length, by only ½ a series of scales - *Apistogramma.*

A problem arises, however, in consideration of *Apistogramma ramirezi,* described by Myers & Harry in 1948[2]. In their original description, they reported that the lateral line in this fish is separated from the dorsal fin by 1½ scales, and that the dorsal count of the species is XIV-XV, 9. According to Regan's key, clearly this fish is a *Geophagus.* (The separation in *Geophagus* is commonly 1 to 3 scales, and the dorsal count "typically" is XIV, 10-12.)

Further evidence that *Apistogramma ramirezi* is actually a *Geophagus* comes from a study of its reproductive behavior. In 1956, Wolfgang Wickler[3,4] investigated the adhesive apparatus of certain cichlid eggs, and devised a classificatory system for such structures. Wickler found that in the eggs of certain *Apistogramma* species (e.g., *A. commbrae, A. cacatuoides,* and *A. pleurotaenia),* the threads are wound together in a corkscrew fashion and lay in a sort of jelly so that the eggs sit on their pointed ends as if on a pedestal. These Wickler termed "p-type" eggs. The eggs of *Apistogramma ramirezi,* on the other hand, are covered with hairs all over and thus stick horizontally to the surface upon which they are laid. Such eggs are termed "1-type" by Wickler. The eggs of the *Geophagus* species studied by him were found to be of the 1-type. (Indeed, the 1-type is common to many cichlid genera.)

As a matter of courtesy, I brought the matter to the attention of Dr. George S. Myers, coauthor of *Apistogramma ramirezi.* Dr. Myers kindly furnished the following information[5]: **"I have known for some time that *Apistogramma ramirezi* is *no Apistogramma* and is perhaps a *Geophagus."*** Although it would be simple enough to place this species in the genus *Geophagus* and to leave it at that, it should be remarked that Dr. James Atz, American Museum of Natural History (New York), is currently in the process of revising the genus *Geophagus.* It might well be that he may find it necessary to erect a new genus for the "ram" (as *Apistogramma ramirezi* is commonly referred to in the hobby). It would seem prudent, however, to refer to the species for now as *Geophagus ramirezi,* at least until Dr. Atz completes his research. Further, as Dr. Myers points out: **"Defining *Apistogramma* (which also would be desirable or necessary) may be more difficult, in part at least due to where to place my *Taenicara candidi* (types in Washington), on which**

I could not identify any lateral line at all under the binocular. If my recollection is good enough, *T. candidi* is close to or identical with *Apistogramma weisei."*

One last matter remains to be clarified. Among hobbyists, the name *"Microgeophagus ramirezi"* has circulated more or less *sub rosa* for a number of years. The source of the term *"Microgeophagus"* is a German aquarium book published in 1959[6]. My translation of the reference is as follows: ***"Microgeophagus* - An eventually establishable genus belonging to the family of cichlids or Cichlidae in which possibly *Apistogramma ramirezi* could be placed."**

Under no circumstances does this qualify as a valid description of a new genus under the International Rules of Zoological Nomenclature. Aquarists are misled if they use it.

SUMMARY

1. *Apistogramma ramirezi* is *not* an *Apistogramma.*
2. For the time being, it seems best to refer to this species as *Geophagus ramirezi.*

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Why Not "Panchax"?

[The Aquarium, April 1971]

Many years ago, when the Dutch settled in the northeastern part of the United States, they brought with them a bit of their own language, which has stayed with us down through thy years. For example, the Dutch word for small waterway or small stream is "kill" and many examples of this word can still be found today, such as the Kill van Kull that separates Staten Island from New Jersey. In this area of the United States many examples of native fishes of the genus *Fundulus* are found, and it was not long before the Dutch term for "fish of the kills" (for this is where they were most common) became shortened to "killifish."

Surprising as it may seem, professional ichthyologists do not always relish the use of long, difficult-to-pronounce scientific names! When the great American ichthyologist, David Starr Jordan, wanted a common name to apply to all members of the family Cyprinodontidae on the North American continent, he decided to expand the definition and use "killifish" as his term. The pioneer specialist in the classification of the whole family, Dr. George S. Myers, later further broadened the definition. Thus, the word is now a short, easy-to-pronounce term for any member of the family Cyprinodontidae. It has logical roots and the support of reputable scientists and professional organizations everywhere.

Other names have been proposed, but they have tended to be either awkward or misleading, or both. The most prominent of this unacceptable nomenclature has been the term "panchax," used mostly by aquarists. Here we must go back some years to the time when ichthyology recognized *Panchax* as a valid generic name. At that time, "*Panchax lineatus*," "*Panchax chaperi*" and others were proper and accepted scientifically. But as times change, so does ichthyological opinion and knowledge, and "*Panchax*" was adjudged unusable and thus was dropped from the rolls of scientific nomenclature. Even in its heyday, however, it never did apply to the whole family and even a subfamily, and so is hardly a fitting term for us to use today.

Simply, then, "killifish" refers to any member of the family Cyprinodontidae.

Note: This article appeared in the very first issue of KILLIE NOTES (February 1962), the first publication of the American Killifish Association.

A New Classification of Anabantoid Fishes

[The Aquarium, April 1971]

The betta is a well-established, long-time member of the aquarium community as is the kissing gourami, the climbing perch, and the pearl gourami. As aquarists, we are all familiar with these fishes to some extent, but mainly taken singly and/or as individual members of their particular species. This is the manner in which they are described in handbooks or in magazine articles. Few hobbyists attempt to back off a bit and to consider groups of species with a view towards learning something about the relationships among them. Yet, this also is an interesting facet of our hobby, a hobby that is unsurpassed in its breadth. This breadth, however, is available only to those who seek it out. A parochial interest in but one fish, for example, qualifies one for the title of "aquarist" only in a very restricted sense.

Historically, many ichthyologists have recognized but a single family of anabantoid fishes, viz., Anabantidae (all of these fishes are from Asia with the exception of two genera originating in Africa), and aquarists have subsequently followed suit (e.g., Innes' "Exotic Aquarium Fishes" treats many anabantoid fishes under this category). There are other arrangements proposed by ichthyologists, of course, but it seems most profitable to consider the latest of these, one based upon a rather intensive and comprehensive study (see reference). The evidence in this study indicates that four major groups (families) should be recognized:

(1) Anabantidae: with species *Anabas, Ctenopoma,* and *Sandelia.*
(2) Belontiidae: *Belontia, Betta, Trichopsis, Macropodus, Trichogaster, Sphaerichthys, Colisa, Malpulutta, Parasphaerichthys,* and *Parosphromenus.*

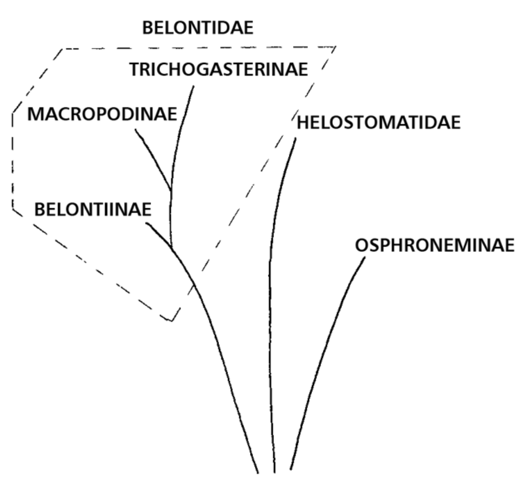


FIGURE 1:
Phylogeny of the anabantoid families and subfamilies.

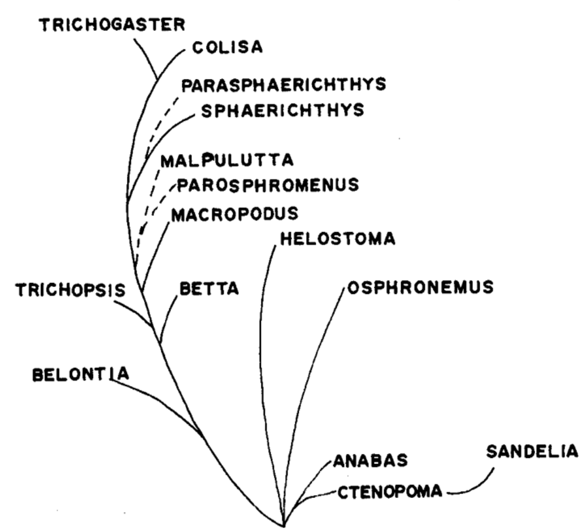
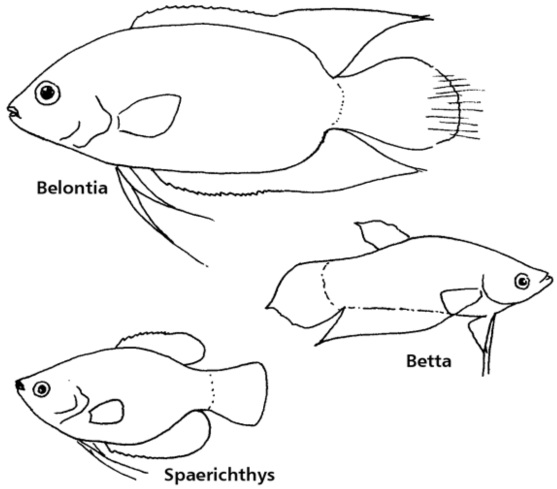


FIGURE 2:
Phylogeny of the anabantoid genera.



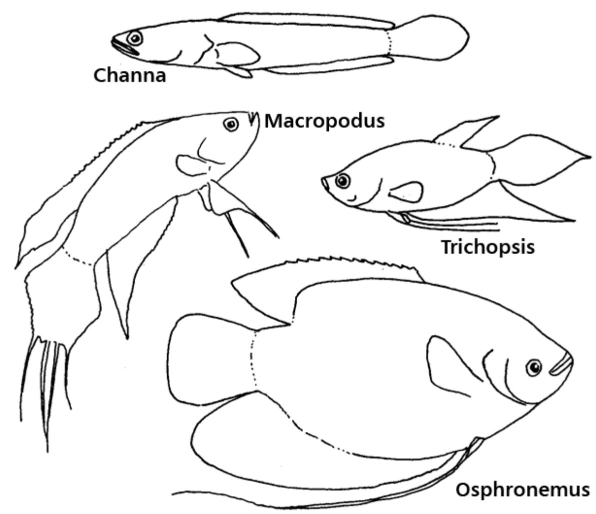
(3) Helostomatidae: *Helostoma.*
(4) Osphronemidae: *Osphronemus.*

Although the majority of the genera listed after the four families above contain, for the most part, familiar aquarium fishes, it is understandable that these scientific names may be quite strange (being mostly "jawbreakers", the same can be said for their pronunciation!). It is hoped that this difficulty will be resolved shortly. Our main concern here, however, is with the "big picture," i.e., an appreciation of the relationships that these important aquarium fish genera hold to one another.

The Anabantidae, a carnivorous group possessing rather large mouths, represents the most primitive family of anabantoid fishes. For example, the climbing perch, *Anabas testudineus, is* known from Pliocene and Pleistocene deposits in Java. The other three families are specialized offshoots of this ancestral anabantoid stock (see Figure 1). There are three genera in the Anabantidae family: *Anabas, Ctenopoma,* and *Sandelia.* The first two are well known to aquarists although earlier authorities (e.g., Boulenger) had lumped both into one genus, *Anabas.* Present-day aquarists know *Ctenopoma* as African "climbing perches" *(Anabas* not being found in Africa). They are widely separated genera but the third, *Sandelia* (isolated on the southern tip of South Africa) appears to have been derived from *Ctenopoma* (see Figure 2). Both *Anabas* and *Ctenopoma* are very hardy fishes, able to sur-

TABLE I

	NUMBER AND FORM OF GILL RAKERS			
	Few & Course	**Many, moderately fine**	**Many, fine**	**Extremely numerous, very fine**
Anabantidae				
Anabas	**X**			
Ctenopoma	**X**			
Sandelia	**X**			
Osphronemidae				
Osphronemus		**X**		
Belontiidae				
Belontia		**X**		
Betta		**X**		
Trichopsis		**X**		
Macropodus		**X**		
Sphaerichthys		**X**		
Colisa			**X**	
Trichogaster			**X**	
Helestomatidae				
Helostoma				**X**



vive in waters of extremely low oxygen content because of their air-breathing capabilities. *Sandelia* (a genus not well-known to aquarists, primarily because aquarium collections are rarely made in South Africa), on the other hand, is less well adapted to air breathing. It does not, as do *Anabas* and *Ctenopoma,* need this as badly since it lives in temperate habitats in which severe periods of drought do not occur. Air breathing, on the other hand, is of great survival value in the tropical swamps of central Africa.

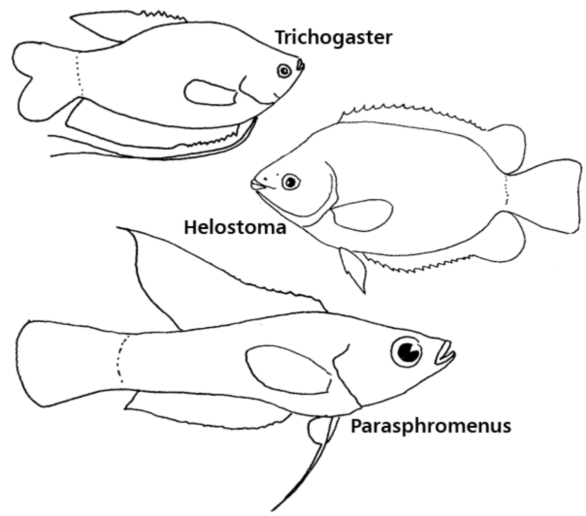
Osphronemus, the sole member of the family Osphronemidae, is a large, broadly adapted fish able to survive in poorly oxygenated waters (and it also has a high salt tolerance, as does *Anabas).* The first ventral fin ray of this fish (very elongated) is both a tactile (touch) and a taste organ. From the specific name of the fish, hobbyists derive the popular name, "gourami." Dr. George S. Myers has observed that one of the evolutionary trends leading from generalized fishes to more specialized ones is the deepening and compressing of the body. This is easily seen in the anabantoid fishes. The members of the Anabantidae are short-bodied forms, while *Osphronemus is* compressed and deep-bodied. As a matter of fact, the most specialized anabantoid, *Helostoma* (kissing gourami), is also quite compressed and deep-bodied. *Helostoma,* the only genus in the family Helostomatidae, exhibits a highly specialized filter-feeding (plankton) behavior, as aquarists well know. The relative position of this family is also noted in Figure 1. *Helostoma,* like *Osphronemus,* developed quite independently from anabantoid ancestral stock (see Figure 2).

The last family (and the largest) is Belontiidae, subdivided into three subfamilies as follows:
(a) Belontiinae: *Belontia.*
(b) Macropodinae: *Betta, Trichopsis, Macropodus, Parosphromenus,* and *Malpulutta.*
(c) Trichogasterinae: *Sphaerichthys, Parasphaerichthys, Casa,* and *Trichogaster.*

The species of the genus *Belontia* are known to aquarists as "combtails." These are fairly compressed and deep-bodied fishes, and represent an intermediate branch on the evolutionary "tree" (see Figure 2). It also seems to be an isolated genus representing the end product of an unpromising evolutionary line.

Many well-known aquarium fishes are represented by the second subfamily (bettas, croaking gouramies, paradise fishes, etc.). *Betta is* an aquarium standby, *Macropodus is* one of our oldest aquarium fishes, and *Trichopsis is* a long-time favorite. The other two, *Parosphromenus* and *Malpulutta* are scarcely known to aquarists although they are not entirely unknown to specialists.

Betta and *Trichopsis* are the most primitive of the Belontiids (especially the former) and it should be noted that these are short-bodied forms. *Macropodus* has a somewhat deeper body. There has been some discussion lately about splitting *Macropodus* into two genera (or subgenera at least) since *M. cupranus* differs considerably from *M. opercularis* and *M. chinensis.* For example, *M. cupranus* breeds in the manner of the betta and also lacks oil containers in its eggs. However, it appears best at



this time to leave the matter at a single genus.

There is an interesting correlation between the structure of the gill rakers and the feeding habits of anabantoid fishes that may be mentioned. Some of this information is summarized in Table I.

Although many authorities have united the snakeheads (ophiocephalids) with the anabantoids, here again we encounter a situation where the resemblance is due to convergence rather than to any close phylogenetic relationship. The recent proposals, therefore, to place the snakeheads in a separate order seem reasonable.

This, then, has been a quick look at the "big picture" of anabantoid fishes. Such information gives us a better appreciation of the evolutionary history of these fishes, and the interrelationships among them. It also serves to keep them in our memory, nicely categorized for ready reference for when the need arises.

We have mentioned that the Anabantidae are carnivorous. The stomach contents of *Trichogaster trichopsis* and *T. leeri* in the wild are composed of plant parts, filamentous algae, and detritus. Other members of the Belontiidae appear to be more omnivorous. Thus, as we move diagonally down in Table I, the fishes become more herbivorous. A similar correlation exists between dentition and diet, but this is of lesser interest to aquarists.

Discussion of anabantoid fishes is not complete until mention is made of two groups of fishes resembling them. The first consists of the monotypic genus *Luciocephalus,* its only member *(L. pulcher)* providing an aquarium fish that is both rare and unusual. Many early workers lumped *Luciocephalus* with the anabantoid fishes although Boulenger placed it in a separate family, Luciocephalidae. Later authorities relegated it to a separate suborder, with the anabantoid fishes forming another suborder (both these suborders belong to the Perciformes order). Although it is true that *Luciocephalus is* an air-breather, it appears that this has been what ichthyologists call "an independent convergent adaptation", meaning that it represents merely an identical solution to problems in adapting to similar environments, and is not a result of any close evolutionary relationship. There is additional evidence that *Luciocephalus is* not related to the anabantoids.

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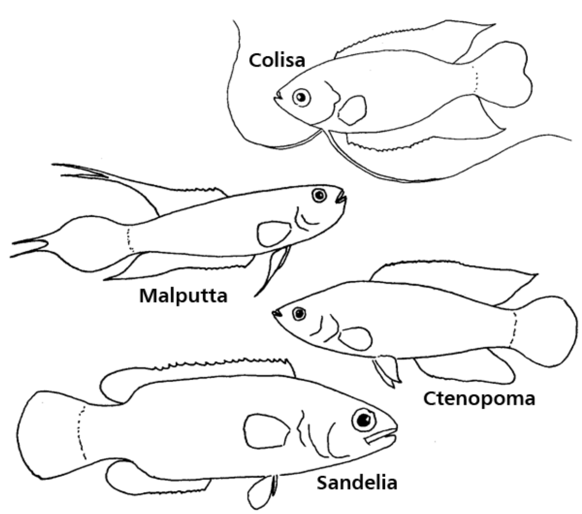


MISCELLANEOUS
FEATURE ARTICLES

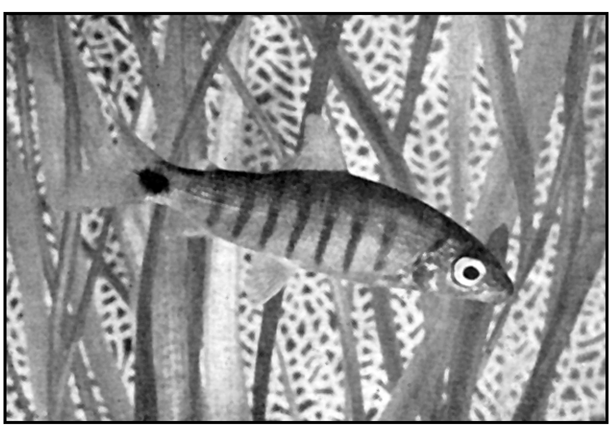
African Fishes of the Genus *Distichodus*

[The Aquarist, August 1956]

Among the aquarium fishes recently imported from the Stanley Pool region in Africa the fishes of the genus *Distichodus* have rekindled an interest for those aquarists who are always seeking something new.

Distichodus are essentially characins, although some specialists place them in a different family, the Citharinidae. In any event, they are characterised by a strongly compressed body and a mouth that is placed on the underside of the snout. The location of the mouth is quite opposite to its location in fishes like *Anostomus,* where it is located topsides. The *Distichodus'* head, viewed from above or below, is broad and rounded. This detail seldom is apparent in the usual tropical fish photograph. In addition, small scales cover the whole or greater part of the caudal and adipose fins.

Anatomical details such as these hardly serve to popularise an aquarium fish, but many of the species are brilliantly coloured or otherwise possess pleasing markings.



***Distichodus atroventralis*. All photographs by the author.**

The following compendium, with the exception: of *D. noboli,* provides a brief description of the species imported into the United States this year. *D. noboli* has been listed in German aquarium books for some time and is often confused with *D. affinis.* A scale and fin ray count has shown our specimens to be *D. affinis.* Other errors have been made in the identification of these fishes and are discussed below.

Synopsis of Imported Species of Distichodus

1. *Distichodus affinis* (Gunther). The photograph illustrates this fish very well. Its basic coloration is silvery. The dorsal fin is very striking, with the anterior half jet-black and the posterior half a bright red. Ventral, anal, and caudal fins are red. There is a black spot at the root of the caudal fin. Length, up to 3 inches. Altogether a very pretty and satisfactory aquarium fish.

2. *Distichodus atroventralis* (Boulenger). This fish has been confused with *D. sexfasciatus* (a basically reddish-coloured fish). The young are greyish to purplish-brown above, white below with six to nine dark vertical bars and a black spot is present at the base of the caudal fin. The adult displays a uniform brown colour. As might be expected from the extremely large eye of the young specimen in the photograph, this species grows to a large size. The adult reaches a length of 17 inches, at which size its head loses some of its roundness.

3. *Distichodus fasciolatus* (Boulenger). Similar to the preceding species, but possessing 18 to 20 dark vertical bars. The young sometimes have a dark brown spot at the base of the caudal fin. There are small blackish spots in the dorsal fin. Length to 14 inches.

***Distichodus affinis*.**

4. *Distichodus lussoso* (Schilthius). This fish is probably the prettiest of the genus. Younger specimens resemble *D. sexfasciatus* quite closely, but they grow to a much larger size—15 inches. Basic coloration is orange or red with six to eight blackish bands across the body. The dorsal fin is blackish in the young. A striking aquarium fish.

5. *Distichodus maculatus* (Boulenger). Very similar to *D. fasciolatus* but for large blackish round spots, forming a rather oblique series across the body, replacing the vertical bars. Each series contains five or six spots. Length, up to 12 inches.

6. *Distichodus noboli* (Boulenger). Closely resembles *D. affinis* but lacks the red markings. Length, up to five inches.

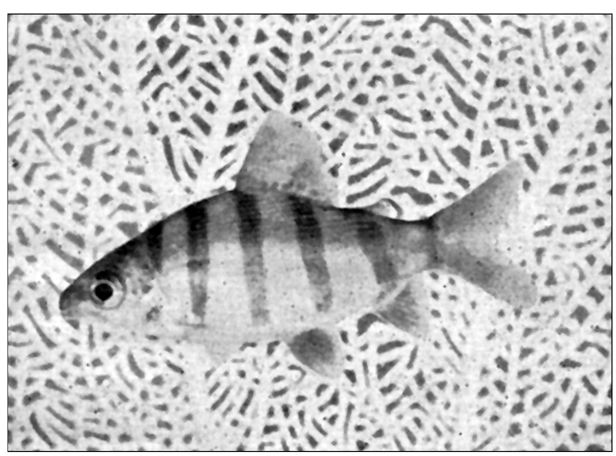
7. *Distichodus sexfasciatus* (Boulenger). Almost as pretty as *D. lussoso,* but in the latter the scales have a lustre lacking in the other. Coloration is red or reddish-brown with a silvery-white belly. Six or seven broad blackish vertical bars decorate the body. A very beautiful fish. Length, up to eight inches.

In aquaria, *Distichodus* behave in a manner resembling barbs. Quite often they can be seen nibbling the new shoots of tender plants but they cannot be classed as plant eaters. The specimens under my observation have eaten frozen *Daphnia* and brine shrimp, white worms and dry foods, thus presenting no feeding problems. In general they are peaceful fish; however, one specimen of *D. sexfasciatus* was seen to bully several *D. affinis.* When this troublemaker was removed to a tank containing larger fishes, including scats, no more difficulty was encountered.

Members of the genus are quite expensive at the present and attempts to breed them have not met with success. Sexing is not easy, but a tank full of *D. affinis* indicated some fish with fuller or deeper body shapes than others, suggesting these as females.

Since *Distichodus* are related to *Nannaethiops unitaeniatus* and *Neolebias ansorgei* they may be expected to breed in a similar manner. Both *Nannaethiops* and *Neolebias* are Congo fishes and lay adhesive eggs upon aquatic plants. All these fishes, including *Distichodus,* come from waters that are very soft and acid, and although in aquaria they do well in a variety of waters, it may be that for breeding, natural water composition must be duplicated.

The breeding of any of the *Distichodus,* with its resulting distribution of these fishes on a wider and less expensive scale, should do much in making them a most desired aquarium fish.



Distichodus sexfasciatus.

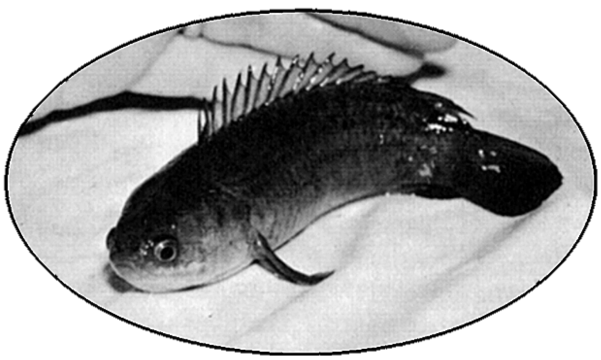
“Nauti” Neighbors

THE ATOMIZER, November 1959]

[Note: This article appeared in THE ATOMIZER, a publication of the National Lead Co. of Ohio while I was working there as a nuclear engineer. It is included because it shows my very first fish room. Two years after this article was published I moved to a much larger house where the size of my fish room was tripled, containing over 120 aquaria of various sizes.]

You may have seen a fish “bowl,” but did you ever see a fish walk?

This is just one of the many really fascinating



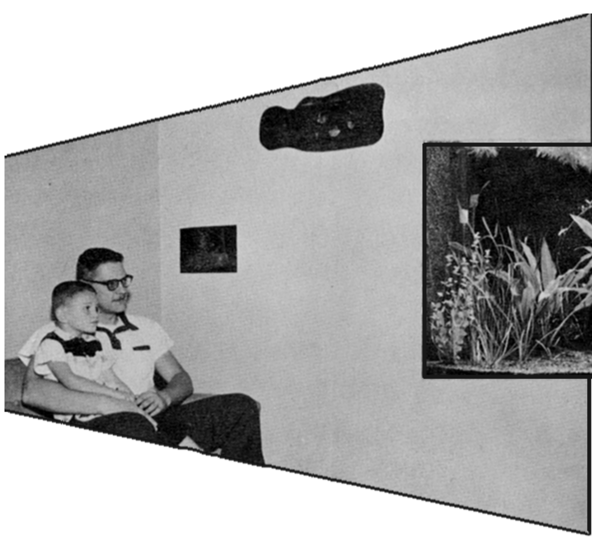
attractions of the home aquarium proudly developed by Al Klee (Accountability Department). Visitors often favorably compare his collection and display of rare and unusual fishes with well-known public aquariums. And it’s no wonder.

The fish room itself is approximately 17’ x 13’ in size and contains over 30 tanks, ranging in size from 21/2 to 180 gallons capacity. Six of the tanks are built into the recreation room wall, where cutouts permit an effective display. Indirect lighting heightens the artistic arrangement of the collection.

Interest centers mainly on the Philippine climbing perch, (pictured elsewhere on this page) which is the walking fish previously mentioned. This fish is capable of surviving outside water by breathing atmospheric air, so long as its gills remain moist. Locomotion is possible thru use of spiny projections on the gill plates, in conjunction with the pectoral fins.

However, many other unusual fishes compete for the visitor’s attention. An American eel, only 11/” long when captured off the coast of Boston, has grown to a length of 9” now. Another remarkable specimen is the “horse head,” a knife fish that is a South American relative of the electric eel. This fish, whose head resembles that of a horse, has no fins except an anal fin, which it uses for propulsion. It can swim backwards as easily as forwards.

One of the American catfishes in the collection

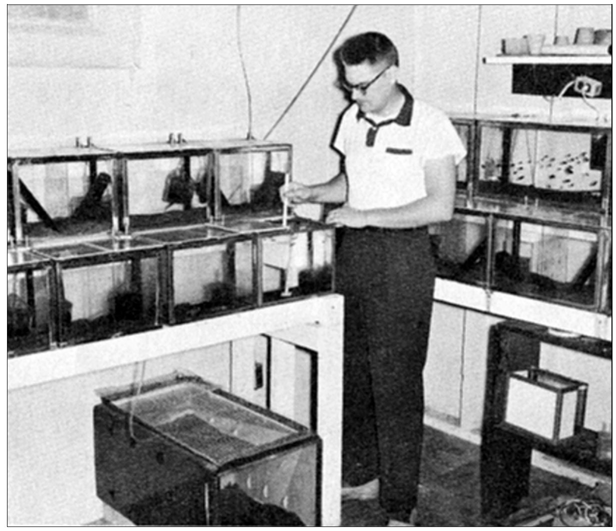


AQUARIA are built into recreation room wall in attractive fashion. Largest tank (enlarged in above photo) is almost 6 feet long, contains 300 lbs. of gravel. Log is small tree with base diameter of one foot. Angelfish are as large as a saucer. (Al is holding son, Eric.)

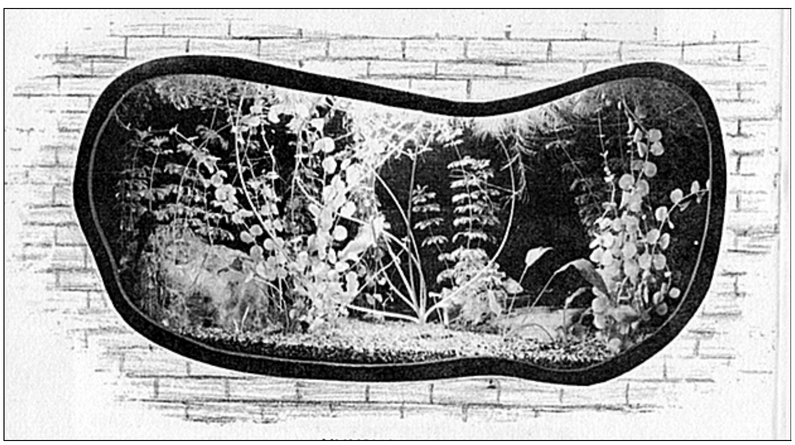
is of the "upside-down" variety. These fishes swim belly - up as a normal way of life and possess a poisonous dorsal spine. This spine secretes a substance that can cause a man excruciating pain if stung.

Other interesting fishes, such as angelfish as large as a saucer, "silver dollars" and zebra cichlids are included in the aquarium. In addition, some tanks contain plant life native to the Far East, particularly to Ceylon and India.

Display is but a minor part of the hobby that Al started in 1948 after he read a book about tropical fish became interested and bought his first tank. Many of the tanks are used for breeding egglaying fishes. Each month hundreds of fish, mostly of the unusual variety, are bred in these tanks.

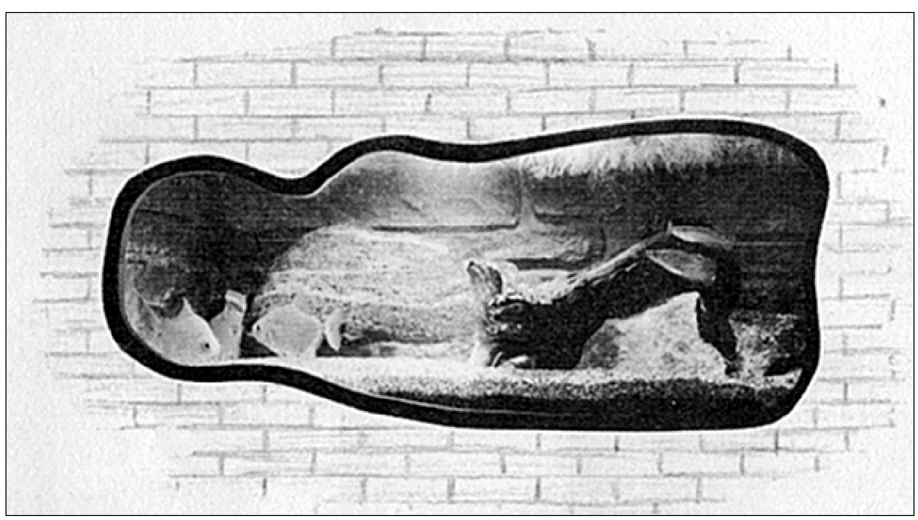


HUNDREDS of fish are bred in these tanks each month. Each tank has a filter and air supply. Small black fish in tank behind Al's left arm are zebra cichlids.

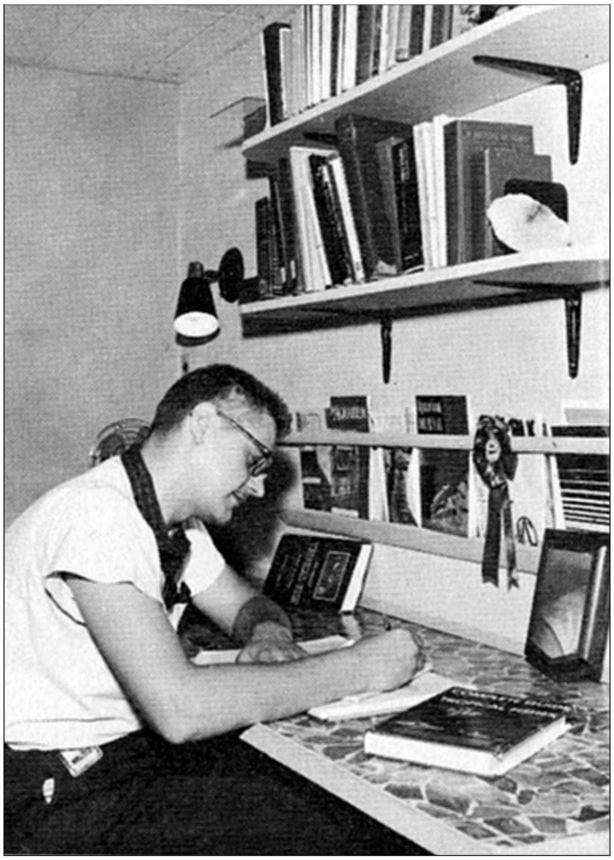


UNUSUAL plant life in above tank is from the Far East, mostly Ceylon and India.

A series of tanks of this nature requires an elaborate filtration system. Every tank has at least one filter, and many have two. These filters, which total about 50, are powered by air, and for this reason an air compressor is located in the garage and the air is piped to the basement fish room. In all, a complex arrange-



"SILVER DOLLARS" seen in the tank to the right were imported from South America. Al also has some African catfish.



SMALL LIBRARY forms backdrop for Al's desk in basement recreation room, as he writes one of three monthly magazine columns. Rosette (ribbon) and plaque (both at lower right were awarded in aquarium fish competition.

ment for air is used. Also, the lighting of all display tanks is controlled by an automatic timer which turns the lights on in early evening and off at 11:00 p.m.

Not a person to pursue a hobby half-heartedly, Al also concerns himself with publications on the subject of aquarium fishes. At present he is writing columns for three national magazines. He reviews about 40 fish magazines each month for one national pet magazine, and has had articles appear in British aquarium magazines and even a Spanish-language magazine in Cuba.

He is a charter member of the Greater Cincinnati Aquarium Society and the Southern Ohio Aquarists. As a service to the latter organization, he and Steve Zakanycz (Chemical Department), publish the S.O.A. Journal, a bimonthly aquarium magazine.

On Nomenclature – Part II

[From FINCHAT, May 1964]

Author's Note: Unfortunately, I do not have access to Part I of this three-part series but as each part deals with a different topic within the main subject, I thought it useful to include the other two parts. *AJK*

AGREEMENT IN ENDINGS OF
SCIENTIFIC NAMES

In Fred Parkes' letter to which I referred in Part I. of this series, another interesting point was brought up: **"Points that confuse me and no doubt others, are such combinations as *Puntius tetrazona,* where one word appears to be masculine and the other feminine."** We now take up this perplexing problem.

The trivial name is usually, but not always, a Latin word. It is usually, but not always (notice how definite I can be when I really try) an adjective agreeing in gender, number and case with the generic name it modifies, e.g., *Colisa labiosa.* If the trivial name is not an adjective it is normally a noun in the genitive qualifying the generic name. Usually such a noun is a modern proper name, either personal or geographic, e.g., *Aphyosemion nigerianum.* Occasionally the trivial name (Note: "trivial" is not to be taken in the ordinary sense. Although readers may think this is an apt term to apply to this series, trivial here means the second part of the name of the species) is a second noun in apposition with the generic name. Here, however, is where most of the trouble starts. The International Code of Zoological Nomenclature does not specify whether to regard as a noun or as an adjective a trivial name that can be regarded as either, where the original author did not clearly indicate which he considered it to be. Among such names are Greek compounds and Latin compounds. Such names may be treated either as nouns or adjectives. This is precisely the difficulty with *Puntius tetrazona,* as we shall see shortly. Before we explain this fully, we need a bit more "ammunition" gleaned from the Rules. For those readers getting sleepy, this might also be a good time for a cup of coffee.

If a trivial name is regarded as an adjective, it must agree in gender with the generic name with which it is at any time combined. Please note that the "any time combined" is important! If for some reason, we alter a genus, adjectival trivial names must be altered to agree in gender with the new generic name. The original name of the killifish in question was *"Fundulus calabaricus," calabaricus* being an adjective (note the adjectival ending, -icus) qualifying *Fundulus* and agreeing in gender, i. e., masculine. But the fish was later transferred to *Aphyosemion,* which is neuter. Accordingly, we must alter the trivial name so that it is neuter also, i.e. *calabaricum.*

On the other hand, if a trivial name is regarded as a noun in the nominative singular (in apposition with the generic name), its ending is not to be changed, regardless of the gender of the generic name. The word "regardless" is the important one here. The problem with *Barbus tetrazona* (we shall argue whether *Barbus* or *Puntius* is "correct" next time; swordtails at 20 paces!) is simply that we do not know whether *tetrazona is* to be considered as a noun or as an adjective. It is is a noun, then *tetrazona is* correct; if it is an adjective, then it must be altered to *tetrazonus* to agree in gender with *Barbus* (or *Puntius).* Since there is an absence of a definite rule in the Code for treatment of such trivial names, confusion in usage is inevitable. It may be of interest to know that a group of eminent scientists is currently preparing a Declaration that should clarify this situation. The Declaration briefly is as follows: **"A trivial name that can be either noun or adjective, and originally published without specification or indication as to which was intended, is to be regarded as a noun in apposition to the generic name."** Thus, if this Declaration is adopted, there will be no doubt as to the validity of *tetrazona.*

It is important to note that the 1961 Code of Zoological Nomenclature provided a great deal of latitude in accepting older trivial names. As a matter of fact, the articles of the new Code dealing with these matters are reduced to a mere recommendation to be observed only in forming new specific names. This brings us to an excellent example of a prime error in the aquarium literature, that of *Barbus stoliczkanus.* Some authors have "corrected" this trivial name to *stoloczkai.* This is definitely an error. It is true that the original spelling, *stoliczkanus,* did not include the recommended adjectival ending, *-ianus,* nevertheless, it does not contravene any mandatory provision of Articles 26 through 31 of the Code. Those authors doing the "correcting" should go back to school or if they persist in writing "authoritative aquarium texts," should at least read the 1961 Rules.

This brings me to another sentence in Fred Parkes' letter: **"Your knowledge of the rules of fish nomenclature appears to be sound, and perhaps you could tell me where I might learn these rules, as the subject is one in which I have always been interested."** Overlooking the fact that "noise" is a synonym for "sound," I am not one to let a friend down! Therefore, Part II concludes with this list of suggested references:

1. ***International Code of Zoological Nomenclature, adopted by the XV International Congress of Zoology*, International Trust for Zoological Nomenclature, London, 1961.**
2. **Hough, J. N., *Scientific Terminology*, Rinehart and Co., New York, 1953.**
3. **Savory, T., *Naming the Living World*, English Universities Press Ltd., 1962.**
4. **Brown, R. W., *Composition of Scientific Words*, 1954.**
5. **Miller, W., *Scientific Names of Latin and Greek Derivation,* Proc. Cal. Acad. Sciences,**

3rd Series, Zoology, 1 (3), 1897: pages, 115-143.

On Nomenclature – Part III

[From FINCHAT, June 1964]

There are instances when the names of fishes are changed, that are not easily defended by simple reference to the International Rules of Nomenclature. For example, it has been stated that the terms *"Aphyosemion calliurum"* and "*Aphanius sophiae"* as currently used by most aquarists are not correct, and that these names should be *Aphyosemion nigerianum* and *Aphanius mento,* respectively. Although the end product is a change in nomenclature, this is really not a matter of nomenclature, but rather of identification. For this, there are no hard and fast rules. One must, then, defend an identification solely upon its own particular merits.

In the case of *Aphyosemion nigerianum,* the defence is easy. The fish in question is clearly a member of the subgenus *Fundulopanchax* as its dorsal fin is set immediately above its anal fin. The true *Aphyosemion calliurum* (which, by the way, has recently been imported as an aquarium fish once again… it resembles *Aphyosemion australe)* is described as a member of the subgenus *Aphyosemion, i.e.,* its dorsal fin is set behind the location of the anal (Killie fanciers… check this on a lyretail and blue gularis, to see these two fundamentally different juxtapositions). Thus, our fish cannot by any stretch of the imagination be the true *calliurum.* But to end the matter, the Danish zoologist, Stenholt Clausen, has recently analysed this problem and stated in print ("Description of Three New Species of *Aphyosemion* from Nigeria and Cameroun," VIDENSK. MEDD. FRA DANSK NATURH. FOREN., bd. 125, 1963) that our fish is *Aphyosemion nigerianum.* Since Mr. Clausen is the leading authority on Nigerian ichthyological matters, we logically follow his lead, not being ichthyologists ourselves. Of course, he may be wrong, but as aquarists, we have no way of knowing this presently, and as a professional, his chances of being wrong are very slim indeed.

In the case of *Aphanius mento,* we observe that the true *Aphanius sophiae is* essentially a Persian fish and that it is strongly barred with vertical stripes (from its original description). The aquarium fish in question is known to have come from Turkey and it certainly is not barred (it has brilliant spots all over its body when in spawning colours).

But again, to end the matter, Dr. Wolfgang Villwock has stated (personal communication to the author, and also see "Zur Synonymie von *Aphanius sophiae,"* MITT. HAMBURG. ZOOL. MUS. INST., Band 58, pgs. 151-154, 1960) that the correct name is *Aphanius mento.* Dr. Villwock is considered to be the world's leading authority on aphanid fishes and so, we accept his statements. Certainly Dr. Villwock may be wrong also, but again as aquarists, we are in no position to judge.

This sort of thing can go on and on forever. A recent issue of Finchat talked about "*Aphyosemion schoutedeni"* (the spelling was a wee bit off though) but this is a synonym for *Aphyosemion christyi* and *christyi* must stand as its correct name. But this is for the present, for there is work going on even as this is being written that may change the name of this fish (perhaps to "*elegans")* for the science of ichthyology is viable, and our scientists learn more every day.

But now let us consider a far different matter. In 1963, Mr. Bruce Turner and I introduced the term. "*Aphyosemion beauforti"* to aquarists. The identification was confirmed in print by an ichthyologist. Since that time, Mr. Turner and I have become convinced that *"beauforti"* is but a synonym for *gulare* (not to be confused with *coeruleum,* which is the

Blue Gularis). Furthermore, an eminent ichthyologist has agreed with us. Now let there be no misunderstanding about this. The fish in aquarists' hands is most assuredly the identical fish as described by Dr. Ernst Ahl many years ago as *A. beauforti.* What we are saying is that *beauforti is* a synonym for *gulare.* This is not the same as the *mento* versus *sophiae* case for that was a matter of confusing two separate and distinct species (both valid). It is more like the *schoutedeni* versus *christyi* case except that there is nothing in print about this by a qualified ichthyologist, so one would have more difficulty in supporting his statement than he would have in the cases mentioned previously.

A very similar situation exists re *Aphyosemion gardneri* and *A. filamentosum* in that the consensus of those who are interested in the classification of the fish we now keep under the name of *filamentosum* (formerly under the name of "*arnoldi'') is* that the fish is properly identified as *gardneri.* However, nothing is available in print about this also. One could go for some time listing the species that are misidentified. One that should "shake up" aquarists is *Epiplatys chaperi.*

The fish we have known for years under this name is not that fish at all! But as this series is not intended to chaotically revise fish names used by aquarists, we shall reserve the details to another time and place.

Passing from killifish nomenclature now to other matters, we encounter the *Barbus-Puntius* controversy. Here is a situation where even ichthyologists disagree and so, where do aquarists stand? The argument, in brief, is as follows. For a number of years ichthyologists have known that the Barbs from the three continents of Europe, Africa, and Asia could not possibly comprise but one genus. Historically, a number of ichthyologists working in restricted geographical areas have subdivided *Barbus* in accordance with the requirements of the technical matters at hand. Thus, Drs. Myers and Oshima subdivided *Barbus* in China and Formosa, Boulenger in Africa, and Weber and de Beaufort in Borneo, Singapore and Indonesia. The last attempt was rather successful, resulting in the widespread use of the name *Puntius,* both in the scientific and aquarium worlds.

But other ichthyologists found difficulty in applying *Puntius* in other areas. Thus, flora, the Indian ichthyologist, continued to recognize *Barbus* in his papers on the freshwater fishes of India, and no ichthyologist working with African Barbs has chosen to abandon *Barbus* there. In short then, the practice in ichthyology has been for those dealing with Indonesian and Siamese fishes to use *Puntius* reverting, however, to *Barbus* for European, African and other Asian Barbs. A number of years ago, an American ichthyologist proposed that *Puntius* be broken down into three genera, viz., *Capoeta (2* barbels), *Puntius* (no barbels), and *Barboides (4* barbels), and that *Barbus* be dropped. This system is open to considerable criticism. As far as barbels are concerned (upon which the proposed system is based), we quote Dr. George S. Myers (Stanford University and Dean of American ichthyologists) on this:

"It seems almost certain that the reduction or loss of one or both pairs of barbels has occurred independently in different evolutionary lines, and may thus be of no importance in establishing genera defined solely by such losses."

That the ichthyological world is sorely in need of a revisional work on *Barbus* there is no doubt. So far as the aquarium world is concerned, however, it is the better policy to utilize *Barbus* for all aquarium Barbs until that time at which the ichthyologists have produced a satisfactory revision. Aquarists are not ichthyologists and therefore are hardly justified in using the specialised nomenclature of *Puntius,* but most assuredly they are incorrect in applying this generic name to anything but Indonesian and Siamese Barbs.

This series was not designed to explain nomenclature or even to serve as an introduction to it (for this I refer the reader to my article in the June, 1964 issue of THE AQUARIUM magazine, "What's In a Name?") but merely to try to answer some of the important points raised in Fred Parkes' letter to me. It is not the liveliest subject in the hobby nor is it followed closely by a great number of aquarists. Here in America we have a commercial product called "NO-DOZ," designed to keep bus drivers, college students, etc., awake. Perhaps a tablet or two should have been clipped to each article in this series. In any event, I had fun writing them, and secondly, I have convinced Fred Parkes to be very careful in asking "a few short questions" in future letters!

Facts About Light

[From THE AQUATIC NET DIGEST, August 1964]

Editor's explanation: I received a letter, about the middle of July from Mr. W.H. Rice, of Rice's Tropical Fish Farm in Florida. Mr. Rice had recently received a shipment of soft-white tubes instead of the warm-white fluorescent tubes he had ordered. He asked me if they were safe to use and would they be as beneficial as the warm-white ones? He had queried his supplier about this question, who in turn asked the Champion Lamp Works about it. Both were polite, but not very helpful. I hesitated to give an ok to the soft-white tubes, because I could not find any information at the time on them. A letter to friend and consultant Al Klee brought the following reply:

Dear Don: Many thanks for your letter of Aug. 1st. The answers (and my comments) are as follows:

1. Re soft-white vs. warm-white, the latter provides more energy in the yellow-orange range while the former provides more energy in the violet-blue range. Warm-white gets its name from the fact that no other fluorescent lamp has as much energy in the "warm" region of yellow-to-rod (total watts 4.8 vs. 4.5 for white, 3.9 for soft-white and all the way down to 2.9 for daylight).
2. Brown's table on page 26 (AQUARIUM Magazine, July 1964) is adequate for such analyses. If you like, you can plot energy vs. wavelength to get a rough idea of the shape of the emission curves. However, the exact curves are available from the manufacturers (and I have used them).

3. My personal opinion would be that if economically feasible, warm-white should be used in any hatchery. The energy in the ultraviolet-to-blue bands is as follows: warm white (both types) 1.6 watts, cool white deluxe 2.5, cool white 2.7, soft white and Gro-Lux 2.8, daylight 3.4 and white 4.1. Since it is this end of the spectrum that is deleterious to fish eggs, warm white is plainly indicated.
4. My 1.8-1.9 ratios are decidedly different from those of Champion Lamp Works for two reasons:

(a) Our ranges for wavelengths differ (I use 4000-5000 Å and 6000-7000 Å vs. Champion's 4300-4900 and 6300-7000 Å). There is good reason for this, viz., these are the ranges of interest for plant growth. In my article* I defined "blue" and "red" light precisely in this manner.
(b) My energy figures only include "effective" energy. For example, check Brown's figure on page 25 (Aquarium, July '64) and look at the 4000-5000Å region. From about 4700-5000Å, Gro-Lux produces a creditable amount of energy but for chlorophyll synthesis, about 60% of it is wasted. Note that plants can utilize almost all of the red in Gro-Lux, however. The figures I gave are adjusted for this phenomenon and thus the term, "effective energy." My analysis was much more penetrating than the superficial view of Champion.

I would like to emphasize one thing more. The 1.8-1.9 ratio refers to optimality for plant growth only, and has nothing to do with either fishes or their eggs. Bear in mind, however, that I have never said anything about the blue range being lethal to fishes, only eggs.

Most people are talking about fish and say very little, if anything, about eggs. The case for fish is still a Scots Verdict, i.e., "Not Proven."

***See "The Lethal Light" by A.J. Klee, in the May '64 AQUATIC NET. Vol. III, No.8 pp 17-21.**

Inheritance of Guanine in the Goldfish

[The Aquarist, November 1964]

The inheritance of reflecting substance in the goldfish has been discussed at length in the aquarium literature (Affleck, 1958 Ison, 1960) but it is by no means a "settled" subject. I do not propose to review this literature in detail, but briefly it has been held that there are three basic conditions, namely, 'metallic', 'nacreous' and 'matt', which depend upon the occurrence of a crystalline material known as guanine in either (or both) of two layers in the skin of a goldfish. The first layer is under the scales and the second is located at the juncture of the dermis and the adipose layer. Should guanine be present in the first layer we have a 'metallic' condition; if in the second layer only, a 'nacreous' condition: if in neither layer, a 'matt' condition. For the mechanics and additional details, I refer the reader to the bibliography appended.

It has been postulated that the mechanism of inheritance of this reflecting material in the goldfish is simple and non-dominant, controlled by a single non-sex-linked gene with two alleles at a single locus. In other words,

TABLE I	
GENOTYPE (GENETIC MAKEUP OF THE FISH)	**PHENOTYPE (PHYSICAL APPEARANCE OF THE FISH)**
MM	Metallic
Mm	Nacreous
mm	matt

the theory would have us understand that there is one allele for metallic, call it M, and another for matt, call it m, and that their manifestation is shown in Table I.

By following this theory to its logical conclusion, the crossing of two 'nacreous' goldfish would proceed as in Table II, resulting in 50 per cent of 'nacreous', and 25 per cent each of 'metallic' and 'matt' goldfish.

Several substantive objections have been made to this theory, however (Morris, 1958; Perkins, 1960). It has been pointed out that goldfish occur in every conceivable intermediate condition between the two extremes of 'metallic' and 'matt'. Furthermore, instances have arisen whereby the phenotype unexpectedly did not adequately reflect 'the presumed genotype and thus we have had devised 'mock-metallic', 'pseudo-matt' and a host of other ingenious terms to describe these conditions. Consequently, I for one do not believe the existing theory and, furthermore, am of the opinion that although the terms 'metallic', 'nacreous' and

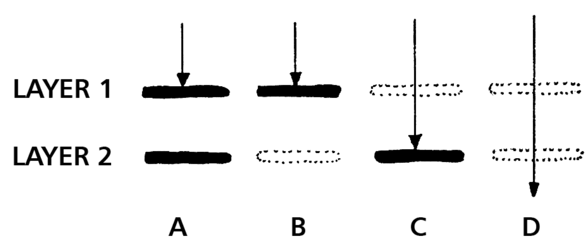


FIGURE 1. Presence of guanine in upper or lower layers of goldfish skin is indicated by black areas in this diagram (see text for details).

TABLE II		
	M	m
M	MM (metallic)	Mm (nacreous)
m	Mm (nacreous)	mm (matt)

TABLE III	
CONDITION	FRACTION OF FISH'S AREA
Metallic	P
Nacreous	(1-p)q
Matt	(1-p)(1-q)

'matt' are valid enough properly used, they leave much to be desired when it comes to using them as adjectives for individual goldfish.

One of the problems is that the inheritance of guanine in the goldfish is controlled by genes acting at two loci, not one. One of the loci relates to the upper guanine layer and the other to the lower layer. Furthermore, the amount of guanine present at each locus is not a qualitative factor but a quantitative one. It is not, for example, a matter of having guanine under the scales or not having any there, but rather a question of what percentage of the layer is covered. Thus we have in goldfish an example of what is known as the "multiple-factor hypothesis." This assumes that there is a series of independent genes (at each of the two loci) for the quantity of guanine in each layer, and that these genes are cumulative in their effect. Each gene, for example, contributes some unit of coverage to the overall coverage in each layer.

Regarding the presence or absence of guanine in the two layers, there are four possible cases (as shown in Fig. 1). Cases A and B result in the 'metallic' condition, case C in the 'nacreous' condition and case D in the 'matt' condition. Assuming random distribution of guanine, suppose p is the fraction of layer number one covered by guanine, and q the fraction of layer number two so covered. The fraction of the area of a given fish exhibiting case A would then merely be pq; the fraction exhibiting case B would be p(1-q); the fraction exhibiting case C would be (1-p)q; the fraction exhibiting case D would be (1-p)(1-q). Since cases A and B both result in the 'metallic' condition, we may add these fractions to obtain simply p. The results of these calculations are summarized in Table III.

For example, suppose p=0.10 and q=0.80. We should then have p=0.10 or 10 percent of the area of a given fish `metallic', (1-p)q=(1-0.10)(0.80)=0.72 or 72 per cent of the area 'nacreous' and (1-p)(1-q)=(1-0.10)(1-0.80)= 0.18 or 18 per cent of the area `matt'. These percentages do not mean that every fish in a given brood will be '10-72-18'. Rather it suggests that the overall, long-term 'average fish' will be 10-72-18. (But beware of averages! The 'average' number on a die is 1+2 +3 +4+5

TABLE IV

GUANINE COVERAGE IN THE F_2 GENERATION
P1 and P2 refer to the grandparents of these fish, having 20 and 80 percent covering, respectively.

	P1, Percentage coverage of guanine in layer number one												
Number of gene pairs	20	25	30	35	40	45	50	55	60	65	70	75	80
1	25						50						25
2	6.25			25			37.5			25			6.25
3	1.55		9.85		23.45		31.3		23.45		9.35		1.55
6	0.02	0.28	1.6	5.4	12.1	19.3	22.6	19.3	12.1	5.4	1.6	0.28	0.02

+6 divided by 6 =3-1/2, but don't expect ever to throw this average; if you do throw 3-1/2, I would be tempted to examine that die very carefully or perhaps switch to a different game!)

We do not know how many genes control the amount of guanine in each layer but it can be shown statistically that the greater the number, the less likely it is to obtain an 'aver-age' fish. As the number of these genes increases, the greater is the variability of any brood. For example, let us just consider the percentage covering in layer number one for a moment. A comparison of the kinds of goldfish populations to be expected in the F_2 generation from grandparents (having 20 and 80 per cent covering respectively) whose differences in the quantity of guanine in layer number one are due to 1, 2, 3, …, 6 pairs of independent genes with equal and cumulative effects and without dominance, are shown in Table IV. The numbers in the Table represent the percentage of any brood having the stated coverage.

These computations tend to suggest that the number of genes at each locus is fairly large since goldfish exhibit a wide variability in the 'nacreous' stage. However, the number of genes can hardly be determined by the aquarist without a good deal of experimentation and some knowledge of biometrics (and even then, the determination would only be a rough estimate).

Admittedly, the inheritance of guanine in the goldfish is by no means simple. I do not see, however, that it serves any useful purpose by posing overly simple models that do not accurately reflect the true state of affairs.

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A Plea

[From *The Finny Bone*, San Francisco Aquarium Society Special Publication No. 3, 1969]

I would like to make a fervent plea to all club secretaries and it is really quite simple. Please drop the word "interesting" from your vocabularies! The plain truth of the matter is that, in club usage, the word is not only hackneyed, but hardly ever bears any resemblance to the truth. You all know what I mean. Check these quotes from club minutes... "...gave a most interesting talk", "...a very interesting program", "...an interesting film"! Surely we can better describe our activities than this?

The most damning indictment of any speaker's presentation is that it was "interesting." Actually this is often but a euphemism for the truth. The Secretary would liked to have said, "While the speaker rambled through his talk, I mentally glazed seven aquariums, bred scats three times and counted the holes in the acoustical tile ceiling". But what do we find in practice? At one meeting a film on the rehabilitation of car thieves was shown by mistake. It still received an "interesting" rating in the minutes.

Of course, there are times when we are at a loss for words. How does the Secretary describe a talk delivered by a speaker who quite obviously is stoned? "Interesting," says the cautious Secretary. An accurate report is the right of every club member, however. "The speaker departed from customary procedure by delivering his talk on multicolor guppies while entirely in the nude. His technique for turning black guppies into gold ones merely by breathing on them prompted a spirited discussion among the members, shortly after those who had been sitting in the front row had been revived."

But perhaps the unkindest cut of all is to have the exceptional presentation treated in this manner also. I would not be surprised if, should a brilliant aquarist announce that within a span of 10 days he had bred *Monodactylus*, crossed a catfish with an inside filter and discovered a cure for water, the Secretary's report still contained the brief comment, "Interesting"!

I should like to make it clear that this is not an indictment of club secretaries. Far from it. They perform yeoman work in a thankless job. The usual method for nominating a secretary, for example, is to do it while she is not there. Experienced club members know full well that the one meeting of the year that simply cannot be missed is the one at which nominations are made. The possibility that an absentee will be nominated for the position of Secretary, Librarian or Chairman of the refreshment committee, is too great to chance. For all but the masochists, the consequences are too terrible to behold.

It Takes All Kinds!

[From *The Finny Bone*, San Francisco Aquarium Society Special Publication No. 3, 1969]

Time and time again, aquarists encounter the "fish phony." Although the old-timers in the hobby can recognize these characters a mile away, the beginning aquarist is sometimes overawed and taken in. Actually, the phony is easily spotted and his most obvious characteristic is the "fact" that he has spawned almost every aquarium fish that has ever been recorded. This includes, as a starter, neon tetras, rasboras, discus, etc. and then finishes off with scats, *Monodactylus*, and clown loaches. Not too long ago, a dealer friend of mine encountered one of these not so rare creatures. The phony was explaining his method for spawning neon tetras. It seems the phony places the breeding tank on a double thick layer of carpeting (to lessen the possibility of vibrations) and covers it with brown paper. The brown paper has a small hole cut in one side. Then, from an adjoining room, the phony uses a pair of binoculars to observe the breeding fishes without disturbing them. This would be a very funny story if the phony were kidding but the fact is, the phony had been telling the story for so long that he really believed it! Upon inspection, the phony not only did not have any neon tetras at home, but my dealer friend couldn't even find a carpet!

Perhaps we aquarists need the services of a good psychologist to tell us why we find frauds in our hobby. No doubt other hobbies have their troubles too. I have been reasonably successful in discouraging frauds by topping their own stories. This not only gives my friends a good laugh, but the phony usually departs the fish hobby for some other. Here is a typical story that you might try the next time a phony comes your way.

"Before discussing their breeding, some observations on caring for scats would be in order. In general, they are exceedingly hardy fishes. I have kept scats in tanks where the water temperature rose to over 120°F. with no discomfort whatsoever. (Of course, the fish died but I suffered no discomfort whatsoever.)

"It is true that they are fussy eaters as live, six inch *Astronotus* placed in their tank are totally ignored. It was only after some difficulty that an acceptable diet was found for these fishes. I feed them a mixture of noodles and sauerkraut about three times daily. Scats are essentially scavengers and this diet closely resembles their natural fare.

"For a long time, hobbyists experienced no little trouble in keeping scats because of the peculiar water conditions in which they are found in nature. They are most observed in brackish water where the effluent water of rivers mingles with the ocean. To simulate these conditions, I utilize, to each gallon, two level teaspoonfuls of milk of magnesia and one aspirin. The only drawback to this method seems to be the difficulty in seeing both fish and plants, but to observe the increased activity of one's scats happily dashing themselves against the walls of their aquarium more than makes up for this minor defect. The aspirin effectively counters any headaches acquired by the fish in this activity.

"Before breeding your scats, they must be sexed. With a little practice this poses no great problem. The method recommended utilizes a garden worm of about 4-inch size. The worm is carefully washed and then dropped into an aquarium cont fining a scat. If she grabs it and eats it, the fish is a female. In a similar manner, if he grabs it and eats it, the fish is a male. Using this method, I have successfully sexed over 1,000 scats.

"The breeding of scats follows the usual cichlid pattern with a few minor deviations. One noticeable difference is that the eggs take care of the parents instead of vice versa. After the eggs, which are cubical with alternating red and blue stripes, are laid, the parents immediately take their positions upon a flat rock or other level surface. The eggs take turns in fanning the parents, ostensible to prevent milk of magnesia particles from falling upon them and causing athlete's fin a disease peculiar to scats.

"After 48 months, the eggs hatch. If the original mating was between two tiger scats, the young fish will be perfect replicas of their parents. If the mating was between two silver scats, the eggs will be infertile and therefore eat the parents. When a tiger scat and a silver scat mate, the offspring invariably result in gold guppies, again proving that Mother Nature knows best."

On Human Dynamos

[From *The Finny Bone*, San Francisco Aquarium Society Special Publication No. 3, 1969]

There comes a time in almost every aquarist's life when he feels the need to exchange experience with kindred souls, the organization providing such an opportunity being the aquarium society. It may be true that the beginner has few experiences to exchange, but both he and the society will benefit by mutual association. The new aquarist will gain a wealth of information from the society and the society will gain new blood and fresh ideas.

Unfortunately, neither of these will come about if society membership is taken in the wrong manner. Participation in the activities of an aquarium society can take the form of two extremes. The first is the "bump-on-the-log" type of member (the type which characterizes the usual beginner) who attends but is silent during the meetings and never volunteers or offers to help out on projects whatsoever. Indeed, some of these members are so quiet that a pulse count is often the only way to ascertain if they are alive. It may be necessary to keep a small mirror handy to hold in front of the "bump-on-the-log" type member's face. If the mirror fogs, then the member is still breathing and is counted in the quorum. If the mirror does not fog, it is the Membership Committee chairman's responsibility to notify the next of kin. Obviously, this type of member is not getting what he should out of the society and vice versa.

On the other hand, we have the "human dynamo" type of member. This earth-bound rocket-of-a-member has his left arm permanently raised over his head so as to be always volunteering for this committee or that project. A typical schedule for the "human dynamo" type of member would be: Chairman of the Special Committee to Place Aquaria in Buses, member of the Committee on Revising Revisions to the By-Laws, in charge of the Kissing Booth at the Annual Fish Show and currently preparing a 45 minute talk on "Constructing Straw Targets for Archer Fishes." These are worthwhile activities, to be sure, but the “human dynamo” soon burns out. As a result, this type of member has never really had time to enjoy his hobby and the society ultimately loses a good man. The best course then is moderation.

On Aquarium Writing

[From a club publication, name and date unknown.]

Some time ago, Editor Ginny Reed wrote a thought-teasing article on the value on aquarium society publications. I would like to extend some of her thoughts and to add some of my own in the process. Broadly speaking, there are four basic types of technical aquarium writing, viz., expository, analytical) descriptive and critical (excluded from this listing are the non-technical biographical and entertainment categories in which we all delight at times), A particular article may embody more than one of these elements, of course, but the elements themselves are fairly distinct, They are characterized as follows:

(a) Expository - Such articles seek to teach. They frequently take the form of a summary of the existing knowledge about a given subject. Aquarium books are generally expository, but many magazines are also.

(b) Analytical - Such articles dissect a given quantity of aquarium information. One starts with the facts, and by a logical process) comes to one or more conclusions, since, given the identical facts, two aquarists may come to different conclusions, analytical writing is often controversial in nature.

(c) Descriptive - Such articles describe, for example, a project, an experiment, or perhaps the breeding of a new fish. Descriptive articles are nothing more than observations. They provide the aquarist with data.

(d) Critical - Strictly speaking, critical writing is also analytical writing, but because it is designed to present judgments upon all of the other types of writing, it is given a separate category, In critical writing) value judgments are made. Such writing is found most frequently in reviews and editorials.

In order to apprise myself of just what the commercial aquarium magazines were doing, I sampled 326 articles at random from six magazines for the year 1963. Each article was classified according to type or else proportioned among two or more types, Reviews, letters, editorials, and columns discussing more than one subject were not included in the survey. Essentially, the survey was concerned with articles only. The findings are presented in Table I.

The survey indicated several interesting items. For one thing, the British and German magazines stood at opposite ends of the spectrum with the British high in expository and low in descriptive writing, and the Germans vice versa. With regard to American magazines, THE AQUARIUM MAGAZINE stood closer to British practice, while T.F.H. stood closer to that of the Germans. The AQUARIUM JOURNAL and TROPICALS, which could hardly be told apart with reference to the survey, stood directly between the British and German extremes. Furthermore, they far exceeded all of the other publications in frequency of analytical articles. T.F.H. made up in criticism, what it lacked in analysis.

It would appear that, generally speaking, American aquarium magazines have obtained a better “balance” than have their European counterparts, Although only two magazines in the survey resembled each other physically (THE AQUARIUM and the AQUARIUM JOURNAL), after many years of reading these magazines, I have in my own mind, paired them as the survey seemed to pair them (e.g., AQUARIST & PONDKEEPER with THE AQUARIUM Magazine, AQUARIUM JOURNAL with TROPI-

PERCENTAGE DISTRIBUTION OF BASIC TYPES				
MAGAZINE	EXPOSITORY	DESCRIPTIVE	ANALYTICAL	CRITICAL
Aquarist & Pondkeeper (British)	72.0	22.7	4.0	1.3
Aquarium Magazine	69.5	30.5	0	0
Aquarium Journal	54.9	33.3	11.8	0
Tropicals	54.2	33.3	12.5	0
T.F.H.	42.5	50.0	0	7.5
DATZ. (German)	35.1	63.6	1.3	0

CALS MAGAZINE, and TFH. with DATZ*). The survey helped to explain why I have done this, even in the face of such striking physical differences among them.

What values are to be placed upon the four categories of writing? Expository writing frequently may be an end in itself, since it may contain all of the particular information the hobbyist may be seeking. Even if it does not, the article may form the basis for additional work, thus saving time, effort. and money for both beginning and experienced aquarists. In either event the expository writer must be sure of the facts and capable of organizing them with efficiency. One of the outstanding expository writers of today is Charles O. Masters. Read his articles (they are mostly concerned with plants or lower organisms) and you will discover exposition at its finest. In a lighter vein, Diane Schofield is par excellence and without peer.

Analytical writing is concerned with unsettled subjects. Thus, there are no “school solutions.” Consequently, there is no guarantee that an aquarist will find the answers to his problems in such writing. The magic of analytical writing is in its generation of ideas. Pursuing an idea to its logical conclusion is relatively easy. Obtaining the idea in the first place is more difficult. Analytical writing, however, if it comes to incorrect conclusions, can actually hinder the aquarist in his search for truth. An example of an outstanding analytical writer is the British aquarist, Dr. F. N. Ghadially. In our own country, a very fine analytical writer is Don Cook.

Much of the same can be said for descriptive writing. Merely because data is presented, one cannot elevate such writing to arbitrary heights. Most aquarium experiments and most aquarium observations are of little value. Strong words? Professional ichthyologists believe that they are true, and I believe it also. Let me cite an example. One of the most common aquarium fishes is the blue gourami. It has been a staple in the hobby for generations, and hundreds of aquarium articles have been written about it. One would suspect that in the area of behavioral study at least (the area in which aquarists should excel), that hobbyists would have had the last word. Nothing could be further from the truth, and I refer the reader to an article by Rudolph Miller in the 1964, No. 3 issue of COPEIA (published by the American. Society of Ichthyologists and Herpetologists) entitled, “Studies on the Social Behavior of the Blue Gourami.” Not only have aquarists been wrong about the blue gourami in many respects these long years, but also their observations have been woefully inade-

***It should be noted that during 1964, THE AQUARIUM Magazine began to devote more space to analytical articles and I no longer consider the pairing with the AQUARIST & PONDKEEPER as strongly as I did before.**

quate. Although professional ichthyologists may have some misgivings about aquarium writing in general, they dare not overlook it, however. It is often referenced in their bibliographies. What then, is the value of descriptive writing? If it is not "pseudoscience", if it does not make a mockery of bona fide scientific words such as "experiment", "control", "significance", "precision" and "accuracy", then such writing is pure gold and should be rightfully saluted, I would without hesitation, cite Arend van den Nieuwenhuizen as the outstanding descriptive writer today.

Critical writing serves to place into perspective, all other writing. It evaluates, counsels and cautions. It may be helpful to author and general hobbyist alike. In a sense, critical writing is more difficult than any other kind. It utterly fails its purpose if it serves merely as a personal soapbox for the critic, however. It has always been a disappointment to me that the writing fraternity does its worst job in the area of criticism. Reviews of books are frequently either fawning or shallow; reviews of articles often degenerate into puerile personality conflicts. In the field of critical writing, Mrs. Helen Simkatis easily outdistances her competition.

Aquarium writers and writing have received increased attention recently, and some comments have exhibited a rather hoggish lack of perception. An attempt has been made to overlook writing for what it really is, i.e., a means of communication. One can be a bricklayer and also a hobby writer; one can be an ichthyologist and also a hobby writer. There is nothing contradictory in either role. If one were to denigrate the bricklayer's writing solely because he was a bricklayer, this would not only be snobbism of the lowest form, but an egregious error as well, Some people overlook the obvious, viz., that there are few professional aquarists in this world, Most of them either design or operate public aquaria. William Braker, Director of the Shedd Aquarium, for example, is a professional aquarist; so is Dr. Earl Herald of the Steinhart Aquarium. A commercial fish breeder is not a professional aquarist, nor are dealers, collectors, magazine editors or publishers. They may, of course, be amateur aquarists; but even, here the word "aquarist" is frequently prostituted (an aquarist is a student of the aquarium, not merely a person who maintains one). Furthermore, an amateur standing does not necessarily mean an inferior standing. The difference between "amateur" and "professional" often is only decided by, how one makes his living. As far as aquarium writing is concerned, I prefer to judge upon the merits of the writing and not upon whether or not the author holds up his shorts with a Phi Beta Kappa key. Our Universities and Colleges have educated far too many fools to be smug about this.

As a hobbyist who does do a great deal of writing, I am not averse to having my own leg pulled now and then. I quote from Sheridan's *The Rivals*:

"Egad, I think the interpreter is the hardest to be understood of the two!"

Ed's. note: Modesty may forbid Al Klee's including his own name among the most respected of aquarium writers; however, we are bound by no such limitation. Al's wit, perception, and articulateness have earned him a reputation as one of the most distinguished authors of aquarium literature (and a gifted cartoonist as well).

The Sex Ratio in Breeding Aquarium Fishes… A Mathematical Analysis

[From ARES REPORTS, date unknown.]

The following thesis was prompted by commonly asked questions such as, "How many females do I use per male?" or, "How many males do I use per female?" Certainly these questions are frequently asked by aquarists but aside from a few dogmatic statements here and there, no aquarist has really answered them to anyone's satisfaction. For one thing, we are asking about numbers or combinations of numbers known as ratios. Thus, to consider this problem on a quantitative basis at all, one inevitably stands face to face with mathematics. This in itself is a disagreeable prospect for some hobbyists. It is not to be denied that other sciences must also be consulted; biology is an obvious example. In any event, it may surprise aquarists to learn that the problem does yield considerably to scientific analysis. If we accept certain reasonable assumptions, there is a definite answer to the questions posed.

In general, the aquarist is concerned with sex ratio problem mostly because of his desire to ensure the maximum egg fertility or, in the case of livebearers, the maximum number of live fry. One could, of course, say that the goal in breeding egg layers is also to secure the maximum number of living fry but this is putting the cart before the horse as we must have fertilized eggs before we have fry, In the livebearers there is nothing much we can do about the eggs and after bringing male and female together, the first tangible products of our efforts are the newborn fry. In any event, there are most certainly a number of factors to consider. A superior female to male ratio (i.e., more females than males) is often used by hobbyists when spawning male or males are inclined to damage the females by aggressive driving. Aggressive driving is perhaps to be welcomed, at least up to the point of damage to the female, since such actions are often a favorable stimulus to the spawning act as a whole. When ripped fins or dead fish are a consequence, however, extra females are used to distribute the pressure among them. Thus, my own preference for spawning most killifishes is one male to two females, On the other hand, certain fishes spawn in pairs only and it would be dangerous to add either an extra male or an extra female under this circumstance. An example would be certain cichlid spawnings. "Intruders," i.e., any third fish, are driven off or murdered.

Leaving aside such factors and considering fishes not likely to damage partner or partners during spawning, what is the answer to the sex ratio problem? At this point, I would like to lead readers down what might appear to be a blind alley. It is intended now to discuss the case of the livebearers, knowing full well that there is no solution to this particular problem. This is because the problem is ill defined for these fishes and the explanation of this statement will be made shortly. My reason for beginning with the livebearers is to provide a sort of background from which we may ease our-

TABLE I

FISH	A	B	C	D	E	F	G	Row Sum, S	$(S - R)^2$
A	-	1	1	1	0	1	1	5	4
B	0	-	0	1	1	0	1	3	0
C	0	1	-	0	1	0	1	3	0
D	0	0	1	-	1	1	1	4	1
E	1	0	0	0	-	1	1	3	0
F	0	1	1	0	0	-	0	2	1
G	0	0	0	0	0	1	-	1	4
								Total, M =	10

selves into another problem with more variables.

Let us consider, for the moment, a population of livebearers fixed in number. If A stands for the number of males, and B for the number of females in this population (population, a statistical term, signifies here merely a group of fishes), then the total number of fishes by our qualifying statement is nothing more than A+B. Now I assert that the number of opportunities for matings is proportional to the number of pairs of individuals, and that this number is AB.

Let us examine this number, AB, more carefully. Suppose we had 8 guppies; 3 males and 5 females. In other words, A=3 and B=5. Then AB =3x 5 or 15, the number of possible matings. One can look at it this way: the first male has 5 females with which to mate (5 opportunities); so does the second male and ditto for the third. The sum total of opportunities is 15. Of course, one could name the fishes, e.g., "Max", "Charlie", "Sam", "Doreen", "Peggy", etc., and then simply list all possible combinations. Try it. You get 15 possible "marriages."

Now assume the aquarist tries to maximize the number of possible matings and thus attempts to maximize AB. A little high school algebra will show that:

$$AB = (1/4)(A+B)^2 - (1/4)(A-B)^2$$

Multiply it out yourself and prove the equation to be true.

From our requirement that the total number of fishes is constant (i.e. A+B is fixed), the only thing on the right-hand side of the equation that can vary is (A – B). If (A – B) is small, AB will be big (check this by looking at the equation). On the other hand, if (A – B) is large, AB will be small. It is evident that (A – B) is smallest when it is equal to zero. If B is larger than A, (A – B) is a negative number but we then square it, making it positive again. Since this is then subtracted from the first part of the right-hand side of the equation, AB would be made small again. Thus, for AB to be biggest, (A – B) must equal zero. However, (A – B) equal to zero is just another way of saying that A equals B. Thus we have shown that for a fixed number of livebearers, the maximum possible number of matings within a reasonable short time interval will occur only when the number of males is equal to the number of females.

TABLE II							
	JUDGE						
FISH	1	2	3	4	5	Row Sum, S	$(S – P)^2$
A	2	4	1	3	1	11	81
B	4	5	3	1	3	16	16
C	3	2	2	4	5	16	16
D	7	3	4	2	7	23	9
E	5	6	6	7	6	30	100
F	1	1	5	6	2	15	25
G	6	7	7	5	4	29	81
						Total, M =	328

Note: In Table II, P = m(n +1)/2 = 5(7 + 1)/2 = 20

It is true, of course, that the maximum possible numbers of matings is not the same as the maximum probable, number of matings. After all, some fish may not mate, others may undergo unsuccessful attempts at matings, and some matings may not "take." Therefore, to get the maximum number of matings, we must multiply the maximum number of possible matings by some fraction, call it k. In other words, the maximum probable number of matings is simply kAB. But for any given set of aquarium conditions (temperature, pH, hardness, etc.), k is a fixed number and does not affect our previous calculations one bit. There is nothing we can do about k since in this problem, the only thing we are allowed to change is the ratio of males to females.

Now that we have come this far) why did we say that this is a blind alley? Let us re-examine the basic assumption we made. We assumed that the goal of the aquarist is to try to maximize the number of possible (or probable) matings. Is this his real goal?

Is it desirable? I think not. An aquarist may purchase hundreds of female livebearers and only one male, then "store" the females until the solitary male has fertilized each and every female. If what is desired is to obtain the maximum number of matings in the shortest period time, then our assumption is good and our conclusions sound. Obviously, most aquarists are little concerned with the time factor and our alley is indeed, blind. The problem is ill defined for livebearers as we have not specified whether or not time is a factor or to what degree.

On the other hand, the same problem in egg layers is well defined. One cannot store unfertilized fish eggs while a solitary male fish takes the time to produce enough milt to fertilize all of them. Unfertilized fish eggs die and that is that, In the case of livebearers we are concerned with the matings of male and female. With egg layers, we are interested in eggs and sperm. A sperm unites with an egg to form a fertilized egg and the objective here is to maximize the total number of fertilized eggs produced. That the time factor is automatically stated for us is clear since eggs not fertilized within a relatively short space of time, die.

Our problem is usually stated in this way: "If I have enough money to purchase X number of fishes, how many should be males and how many should be females?" Here I would like you to consider that you are not buying fishes but rather buying eggs and milt. In other words, each female in this problem really represents a given amount of eggs, and each male a given amount of milt, Then we may ask a different question: "If I have enough money to purchase a certain mass of sexual products, how much should I spend on eggs and how much on milt?" It will be shown that the answer to this question ultimately provides us with the answer to our original one.

Suppose we are given, M. the total mass of sexual products we can afford to buy. This must be apportioned in some manner, between, E, the total mass of eggs purchased and, S, the total mass of sperm purchased. Suppose further that the mass of a single egg is, e, and that the mass of a single sperm is, s, Then, A, the number of sperms we can buy is $A = S/s$
and B, the number of eggs we can buy is
$B= E/e$.

Now the union of a sperm and an egg results in a fertilized egg and we wish to maximize the number of such fertilized eggs, As with livebearers, this maximum number is, AB. Our earlier remarks about possible versus probable successes will hold here also and so we may neglect a constant term reflecting the fact that not all sperms live or can reach an egg. Thus, $AB= (S/s)(E/e)$.

If we wish to maximize AB, it is clear we must maximize SE as se is fixed and we can do nothing about it. Refreshing our memories with our livebearer discussion, we note that:

$$SE = (1/4)(S + E)^2 - (1/4)(S - E)^2$$

Recall that our basic assumption is that S + E (or M) is fixed, i.e., we have fixed amount to spend. Again, to maximize SE, S - E must be equal to zero and therefore, S must equal E.

We have just determined that the total mass of sperm that we buy must be equal to the total mass of eggs we buy. As aquarists, then, it merely remains to match up our fishes in such a way so as to insure that the total mass of spermatozoa matches the total mass of eggs produced.

Now in fishes, the assimilarity powers of males and females are not very different (assimilation is merely the conversion or incorporation of nutritive material into the fluid or solid substance of the body),, Thus, each produces about the same mass of sexual products and we conclude that the optimum ratio of males to females is 1:1, or one male to each female. Although it might appear that the total volume of sexual products produced by the female fish far exceeds that of the male, this is merely because of the water absorption and water content of the egg. Biologists tell us that, in effect, the mass of germplasm plus reserve (i.e., yolk) produced by the female fish is approximately equal to the mass of germplasm produced by the male.
In conclusion, under our assumption we have shown that those aquarists deviating from a 1:1 sex ratio for the purpose of maximizing the number of fertilized eggs produced when breeding egg layers, are in error. There certainly may be valid reasons for such deviations but this is not one of them.

The Fighting Fish Problem

[From a publication of the Chicago Aquarium Society, name and date unknown. Note: I was challenged to come up with an aquarium puzzle. After a few G and T's, I came up with the following. *AJK*]

The gambling instinct in Siam (now called Thailand) runs strong and consequently, the natives have developed the fighting proclivities of the local species of fishes to a high degree. The first species is the well-known fighting fish of Siam (Betta splendens), the- other-being the Siamese wrestling fish or halfbeak (Dermogenys pusillus). Although normally these two species will not bother each other, the addition of some kabong (the local version of our mountain dew) to the aquarium produces dramatic results and a fight to the finish.

Now three halfbeaks are a standoff for one betta; four halfbeaks, however, can dispatch one betta to fish heaven in ten minutes and additional halfbeaks reduce this time proportionately (i.e., five halfbeaks take 8 minutes, six halfbeaks take 6-2/3 minutes, etc.). The halfbeaks know that a single betta can easily vanquish a single halfbeak on even a pair; therefore, the halfbeaks always attack in trios or more. In addition, once they start an attack they do not leave the betta until it has gone to its just reward.
Some natives place four bettas, thirteen halfbeaks, and three fingers of kabong into a 15-gallon, aquarium. Who wins the fight and how long does it last?
Editor's note: I will personally buy any member who comes up with the right answer at our February meeting, a drink, a good cigar, a pack of cigarettes or an ice cream sundae. Name your. Poison! The answer will be printed next month. Come on all you mathematical wizards - here is a challenge for you! Any of our readers who can figure out this one will receive public acclamation in the- next issue so put an your thinking caps and solve this puzzle. Thanks Al for this intricate problem. It taxes the mind as well as the imagination.

Note: The solution to this problem is found in the Appendix.

Some Quantitative Tests For Fish Judges

[From a club publication, name and date unknown.]

One aspect of the hobby today that seems to be growing more important with the passage of time is the public exhibition of aquarium fishes. Not only do clubs run monthly "table shows" and annual exhibitions, but there are regional shows, international shows and shows sponsored by large cosmopolitan organizations such as the A.G.A., T.I.F.A.S. and the A.K.A. Shows, like everything else, suffer from certain imperfections. Since the heart of the show lies in its judging, it is not surprising that a good many problems are centered here. There is always some dissatisfaction with judging at any show. In many respects, judging is an art and as with any art form, it is difficult to please everyone.

Some clubs and regional organizations have attempted to improve the quality of judging by conducting schools for judges. The problem remains, however, "Who judges the judges?" This article is intended as a partial solution to the problem.

Certainly, one characteristic of a judge must be that he is consistent in his judgments. He may he consistently right or consistently wrong, but consistent he must be. A test for consistency can be devised on the basis that a direct comparison between two fishes is far more sensitive and discerning than actual measurement on a given scale of values. The problem therefore is approached on the basis of paired comparisons, presenting the judge with every possible combination of two fishes from the set to be evaluated, providing him with the opportunity to make inconsistent judgments. This could not be done on a formal ranking basis such as the one we shall use in another context to be considered later.

We desire then, to compute a Coefficient of Consistency, K, which varies from 0 (representing the maximum number of inconsistencies possible) to 1 (representing no inconsistencies). Let us present the fledgling judge with all possible pairs of n fishes (one pair at a time), asking him to state which member of each pair is preferred to the other. The results of such an experimental test for 7 fishes is shown in Table I.

We adopt the following convention. The "1" in row A, column B indicates that the judge preferred fish A to fish B. The "0" in row A, column E indicates that fish A was not preferred to fish E (i.e., "E" was preferred over "A"). Note that we do not fill in the diagonal in the array of numbers, for we do not compare any fish with itself.

Next, each row sum, S, is computed. Then R is subtracted from each S and the result squared. The negative signs that might result from this subtraction are ignored for the squaring process automatically makes all results positive.

TABLE I

FISH	A	B	C	D	E	F	G	Row Sum, S	$(S - R)^2$
A	-	1	1	1	0	1	1	5	4
B	0	-	0	1	1	0	1	3	0
C	0	1	-	0	1	0	1	3	0
D	0	0	1	-	1	1	1	4	1
E	1	0	0	0	-	1	1	3	0
F	0	1	1	0	0	-	0	2	1
G	0	0	0	0	0	1	-	1	4
								Total, M =	10

The factor R is easily computed from the formula,

$R = (n - 1)/2$

where n is the number of fishes in the test (i.e., 7 in this case).
In this example, $R = (7 - 1)/2 = 3$

Next, the column of numbers, $(S - R)^2$ is totaled, the total being termed, T. If n is odd, the Coefficient of Consistency, K, is given as:

$K = (12\ T)/(n^3 - n)$
If even, it is:

$K = (12\ T)/(n^3 - 4n)$

Since n is odd in our example, the Coefficient of Consistency is:

$K = 12(10)/(7^3 - 7) = 120/(343 - 7) = 0.356$ or 35.6%

This judge, then, is somewhat inconsistent. Minimum requirements based upon the scores of experienced judges or an absolute standard of the judging school may be devised as desired.

At a show, there is usually a team of judges ranking each entry. A desirable feature of such team judging is that there be agreement in essence among the judges. As a measure of such overall agreement, we compute the Coefficient of Concordance, C, for the team's results. Table II presents the rankings of each of 5 judges for 7 different fishes (the ranking may be obtained from each judge's point total or from direct ranking if that is the method of judging used). A tie, say between 3rd and 4th place, by the way, would be handled by calling them both 3-1/2 in rank.

Each row sum, S, is computed. Then P is subtracted from each S and the result squared. P is obtained from the formula:
$P = m(n + 1)/2$

where n is the number of fishes judged, and m is the number of judges. We total this last column to obtain M and the Coefficient of Concordance, is given as:
$C = 12M/[(m^2(n^3 - n)] = 12(328)/5^2(7^3 - 7) = 3936/8400 = 0.468$ or 46.8%

There is then, only fair agreement among these 5 judges. Again, judging schools and/or clubs may set minimum standards for the Coefficient

TABLE II

	JUDGE						
FISH	1	2	3	4	5	Row Sum, S	$(S - P)^2$
A	2	4	1	3	1	11	81
B	4	5	3	1	3	16	16
C	3	2	2	4	5	16	16
D	7	3	4	2	7	23	9
E	5	6	6	7	6	30	100
F	1	1	5	6	2	15	25
G	6	7	7	5	4	29	81
						Total, M =	328

Note: In Table II, $P = m(n + 1)/2 = 5(7 + 1)/2 = 20$

of Concordance as they see fit. In addition, a fledgling judge may be matched against an experienced judge (m = 2 in this case) and the Coefficient computed to see if the tyro meets the specifications set by the school or sponsoring organization.

This discussion, of course, merely scratches the surface of these problems; but it is a start, at least, for introducing quantitative standards for judges. Should any responsible organization require assistance in implementing the techniques described, I would be pleased to cooperate.

On The Instability Of Generic Names

[From a publication of the British Ichthyological Society, name and date Unknown.]

The guppy is no longer *Lebistes*; the mollies are no longer *Mollienesia*. Both have recently had their names changed, thus furnishing us with a starting point for a discussion regarding the instability of generic names of fishes. Perhaps, however, a few words should be said about the position of the genus in the classification hierarchy before we explore the problem in further detail. It is true that the genus is a different sort of category from those of a higher level still, (i.e. family, order, etc), for it has a special status both traditional and nomenclatural. For one thing, it is a convenient unit for discussing fishes. Members of the same genus frequently share the same aquarium requirements and the same reproductive patterns. As an example, if one has described one barb, he has described almost all of them. (I say 'almost' as there are barbs, for example, which breed in the manner of annual killifishes).

The ichthyologist formulates his genera on the basis of three factors: (a) degree of separation (gaps) of selected characters from one genus to the next, (b), the degree of divergence of these characters, and, (c), the multiplicity of lower classificatory units (i.e. species). The first two factors are associated with the similarity of one form to another. Traditionally, the ichthyologist studies his fishes and then arranges them in a series based upon characters. Such as scale and fin counts, osteology, etc. A barb, for example, is very much like a rasbora in these features but is far removed from the analogous qualities in a lungfish. As for the third factor, let us suppose that an ichthyologist had ten species equally spaced as far as the qualities under consideration were concerned. He would have a choice between (a), placing all of them into a single genus, or, (b), devising ten genera, - a separate one for each of them. Those tending towards the former course are sometimes termed 'lumpers', and those who favour the latter are sometimes called 'splitters'. The sum of the activities of these two groups tend to what might seem to us at times as generic instability.

It has been said there are really no objective criteria for genera. Perhaps this is true, but even so, there are decided practical considerations. When one has scant knowledge of a group of fishes, there is a bias towards emphasizing the differences among them. As our knowledge increases we are more interested in their similarities. It takes no great mind to recognize a difference; on the other hand, appreciation of a similarity requires a powerful intellect. Recall that those men of history whom we associate with the word 'genius' were generalists and not specialists. Newton's genius was in the amalgamation of many thoughts, not the interminable dissection of but a single one. The same might be said of Albert Einstein.

Because the generic name is an integral part of the scientific name, stability in its use is to be desired, but its ability to express relationships should not be sacrificed. This is why Drs. Donn Rosen (American Museum of Natural History) and Reeve Bailey (Museum of Zoology, University of Michigan) in their current revision of the livebearers (Poeciliidae), place *Lebistes, Mollienesia, Limia, Micropoecilia*, and some others in the genus *Poecilia*. The guppy now becomes *Poecilia reticulata*, returning at last to its very first name! The *sphenops* molly becomes *Poecilia sphenops* so these changes make sense. They explain for example, the occasional guppy x molly crosses that occur in aquaria.

This is not to suggest, however, that the reverse process, (that of splitting off genera) does not occur in ichthyology. An interesting example is the work of Dr Wolfgang Wickler in Germany with regard to *Haplochromis*. Dr Wickler has shown that the anal fin ocelli (the large spots there … Dr Wickler refers to them as 'egg dummies') in this genus play an important role in the spawning act. The female lays her eggs and picks them up in her mouth. Then the male spreads his anal fin before her, and thinking the anal ocelli are eggs, she attempts to pick them up also! This ensures close proximity of the pair and the male releases his sperm, assured that it will mix thoroughly with the eggs in the female's oral cavity.

However, the Egyptian Mouthbreeder does not possess such ocelli, and its spawning procedure is quite different. As a consequence, Dr Wickler has devised a new genus for it, and this fish now becomes *Hemihaplochromis multicolor*. The difference between *Haplochromis* and *Hemihaplochromis* is behavioral; that between mollies and the guppy is mainly of variations in the structure of the gonopodium. Therefore, for two entirely different reasons, the generic names of cichlids and livebearers have been altered. Do the changes make sense? The aquarist's answer is a resounding 'Yes'! for relationships have become clarified. By crosses, aquarists have always known the guppy and molly were close; by spawning experiments they also knew the Egyptian mouthbreeder differed from such fish as *Haplochromis wingati*. It is clear that relationships between species or groups of species are reflected in many features, some anatomical, some behavioral, and many others. When the changes in generic terminology better relate these features, then we are entitled to tinker with generic stability.

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Rosen, and Bailey, "The Poeciliid Fishes, Their Structure, Zoogeography and Systematics" BULL. AMER. MUS. NAT. HIST., 126, Article 1, Pp 1- 76, 1963.

Wickler, "Zur Klassification der Cichlidae, am Beispel der Gattungen Tropheus Petrochromis, Haplochromis and Hemihaplochromis n. gen." Senck Bio., 44, No 2, Pp 83--96, 1963.

When the idea of a national organization of killifish hobbyists first came to my mind, it was the possibility of producing and providing killifish literature on a scale not ever seen before that interested me the most. It is true that articles appeared from time to time in the commercial tropical fish magazines of the day, but they were few and far between and none of them had the depth needed to advance the killifish hobby in any meaningful way.

When the AKA was opened to Charter Members in 1962, we needed a periodical to inform members of activities both within the Association and within the hobby; thus, *Killie Notes* was born, under the editorship of Robert O. Criger, the co-founder (along with myself) of the Association. It was also clear that two booklets were urgently needed, i.e., a beginner's guide and a guide to sending both eggs and fishes. To this end a Publications Committee was established with Bob and me as Co-Chairmen. Our duties were split as follows: I was responsible for obtaining content and Bob was responsible for layout and printing. As Chairman of the first Board of Trustees my time was mostly taken up with Association business and plans for the future, but we did manage to publish the "Killifish Exchanges," edited by Richard Haas and me, and the "Beginner's Guide," co-authored by Alan Markis and Roger E. Langton.

In 1963 I took over as Editor of *Killie Notes* from Bob Criger for one year. By 1964 it was decided to abandon the Publications Committee and replace it with a Technical Publications Committee, with me as chairman. It was at this point that I became actively involved with the introduction of both new serial and non-serial publications. With regard to non-serial publications, my first endeavor was to put together the killifish portion of Boulenger's "Calalogue of the Fresh-water Fishes of Africa," and my second was to do the same for the killifish portion (translated) of Arnold and Ahl's "Fremdländische Süsswasserfische." The latter, however, was far more involved than the Boulenger book and so George Maier and I collaborated in this effort, George doing the translation and me doing the reproduction of the line drawings and the technical editing. Robert J. Goldstein took on the job of editing and final typing of the manuscript, assisted by Bobby L. Middlebrooks. The production of the final product, including the typing of the masters and supervision of the printing, was accomplished by Robert L. Horton.

With regard to serial publications, it was clear that the AKA needed a publication separate from *Killie Notes* in which to publish killifish articles. Thus the *Journal of the American Killifish Association* was launched under my editorship. A year later I started *The Killifish Index* as a concise reference to the various killifish species. It was and still is a continuing work, published at irregular intervals in loose-leaf form. When necessary, supplemental correction sheets were issued to keep the Index up-to-date. As with *JAKA*, I passed the reins of editorship over to others so that I could indulge in my first love, that of writing about killifishes.

The following are the articles I wrote over a 43-year period for *Killie Notes* and *JAKA*. Some are of historical nature but the majority involves either description of new fishes, identification of species or matters involving classification. There are two minor technical corrections to the article "The Most Peculiar Killie" involving the definition of its trivial name and the mislabeling of the ventral fin as the pectoral fin in one of the figures, and one to the article "A History of Aquarium Killifishes" where the importation of *Nothobranchius orthonotus* was cited as 1936 when it should have been 1926. All other corrections are mostly orthographic in nature.

In my opinion, the most important of these articles include (1) "A History of Aquarium Killifishes," in which the year of importation into the aquarium hobby for 91 species is documented; (2) "The Christyi-Cognatum Problem Revisited, in which the first use of electrophoresis to help make decisions on the identification of these two species was described;
(3) "The Killifish Egg," which was reprinted twice more in later AKA publications after its initial appearance; (4) "On the Identity of the 'Achilles' *Rivulus*" and the three Letters to the Editor that it occasioned; and (5) "What's in a Name? The Meaning of 'Killifish,' Parts I and II."

The Achilles *Rivulus* article is interesting in that it involved a disagreement between me and Col. Joergen Scheel over identity of the fish. As I said in my reply to Col. Scheel's comments, "It is true we do not agree on all matters piscatorial. However, I consider Col. Scheel a distinguished adversary in those instances when we disagree, whose criticism is always valued. A good part of our divergence in nomenclatural matters is due to the fact that Col. Scheel is essentially a "splitter" (especially in generic terms) whereas I am a "lumper." I should note that as I was not the editor of JAKA at the time, I had no control over what was printed in this exchange so it was quite a surprise to both of us when Dr. George S. Myers jumped into the fray and had the last word.

The "What's in a Name?" article is probably the most exhaustive article ever written about the killifish name and its predecessor, "*Panchax*." It also discussed the difference between classification and nomenclature, and was the first instance of the mention and explanation of cladistics in the aquarium literature. The bibliography accompanying this article has 47 entries, which holds the record for any of my aquarium articles!

Why Not "Panchax"?

by Albert J. Klee

Killie Notes Vol. 1, Issue 1, p. 7, 1962

Many years ago, when the Dutch settled in the northeastern part of the United States, they brought with them a bit of their own language which has stayed with us down through the years. For example, the Dutch word for small waterway or small stream is "kill" and many examples of this word can still be found today, such as the Kill van Kull which separates Staten Island from New Jersey. In this area of the United States many examples of native fishes of the genus *Fundulus* are found, and it was not long before the Dutch term for "fish of the kills" (for this is where they were most common) became shortened to "killifish."

Surprising as it may seem, professional ichthyologists do not always relish the use of long, difficult-to-pronounce scientific names! When the great American ichthyologist, David Starr Jordan, wanted a common name to apply to all members of the family Cyprinodontidae on the North American continent, he decided to expand the definition and use "killifish" as his term. The pioneer specialist in the classification of the whole family, Dr. George S. Myers, later further broadened the definition. Thus, the word is now a short, easy-to-pronounce term for any member of the family Cyprinodontidae. It has logical roots and the support of reputable scientists and professional organizations everywhere.

Other names have been proposed, but they have tended to be either awkward or misleading, or both. The most prominent of this unacceptable nomenclature has been the term "panchax," used mostly by aquarists. Here we must go back some years to the time when ichthyology recognized *Panchax* as a valid generic name. At that time, "*Panchax lineatus,*" "*Panchax chaperi*" and others were proper and accepted scientifically. But as times change, so does ichthyological opinion and knowledge, and "*Panchax*" was adjudged unusable and thus was dropped from the rolls of scientific nomenclature. Even in its heyday, however, it never did apply to the whole family and even a subfamily, and so is hardly a fitting term for us to use today.

Simply, then, "killifish" refers to any member of the family Cyprinodontidae.

Remarks On the Identification of Three Aphyosemions

by Albert J. Klee

Killie Notes Vol. 1, Issue 1, pp. 8-10, 1962

A number of times in the past, I have been queried on the problem of distinguishing among the following three species of *Aphyosemion: Aphyosemion arnoldi, Aphyosemion filamentosum*, and *Aphyosemion gardneri*. Why should any problem exist? The answer to this lies in the fact that both American and German aquarium handbooks have interchanged these names freely in the past, resulting in considerable confusion among killifish fanciers.

From a historical point of view, our first fish was *Aphyosemion arnoldi*, described in 1908, followed by *Aphyosemion gardneri* in 1911, and finally *Aphyosemion filamentosum* in 1933. All three fishes were reported to come from about the same area, namely, the Togo to Cameroons strip along the west coast of Africa.

My first introduction to any of these fishes occurred in 1950 when a local dealer received 20 aphyosemions of which 19 were females. As far as aphyosemions went at the time, this particular species was not especially pretty. Basically, it was of a purplish body color, liberally sprinkled with maroon dots.* The dorsal, anal and tail fins were edged in dark red. The tail of the male had three points on it, but these were not especially elongated and, for that matter, neither were any of the tips on other fins of the male (see figure 1).

FIG. 1 - My first *Aphyosemion gardneri*, received in 1950.

I checked my copy of Innes's "Exotic Aquarium Fishes," and found a fish labeled, "*Aphyosemion gardneri*," but it didn't resemble my fish in the least for this fish had larger and longer fins, and entirely different coloration. Innes' fish was a beauty, mine was a bust! Then I checked my copy of "Die Aquarienfische in Wort und Bild" (the "bible" of the German aquarist at the time) and found a fish labeled, "*Aphyosemion gardneri*," that was the exact image of my fish. It looked nothing at all like Innes' "*gardneri*." Not too many pages away I found Innes' fish but it was labeled, "*Aphyosemion filamentosum*"**!** Now I was really confused and laid the matter to rest for a few years.

Some years later I received some killies identified by the shipper as "*Aphyosemion arnoldi*." When I examined them closely, (figure 2) they appeared suspiciously close to the "*gardneri*" of Innes', and the "*filamentosum*" of the Germans. But then, there were some slight differences so I

*A year later, a steel-blue colored variation appeared on the market.

FIG. 2 - The short-finned version of *Aphyosemion filamentosum* received in 1958.

FIG. 3 - Drawing of *Aphyosemion filamentosum* from Meinken's original description.

shrugged it off. After I had bred the fish, I noticed that a few offspring in the second generation approached "*gardneri-filamentosum*" almost exactly. As a matter of fact, this fish turned out to be an extremely variable fish, the offspring of which differed considerably among themselves in pattern and finnage. At this point I was fed up with the confusion in names and decided to look these fishes up in some ichthyologic references. (See figures 3, 4, 5).

The first thing I learned was that *arnoldi* and *gardneri* in their original descriptions differed quite a bit, but that *gardneri* and *filamentosum* differed much less. For example, the fin counts were as follows:

Species	No. of Dorsal Rays	No. of Anal Rays
arnoldi	15-16	15-17
gardneri	12-13	14-16
filamentosum	13	14

The differences between *gardneri* and *filamentosum* were mainly in coloration and fin shape although in *gardneri*, the dorsal began exactly over the front of the anal, while in *filamentosum*, the dorsal began a bit in front of the anal. Thus I concluded, (a), that the purplish killie I received in 1950 was *Aphyosemion gardneri*, (b), that the fish I now had was *Aphyosemion filamentosum* and (c), that the real *Aphyosemion arnoldi* had never been imported into this country.

In the meanwhile, all these names bounced around quite a bit in the aquarium literature. Recently there has been a lot of talk about *filamentosum* being a subspecies of *arnoldi*, *filamentosum* being a subspecies of *gardneri*, etc. The first I cannot see at all since these two fishes differ greatly in size, fin count, dorsal to anal juxtaposition and length to width ratio. The second idea may have some merit, indeed, due to the variability of "*filamentosum*." I would be convinced that it and *gardneri* were one and the same species were it not for the fact that there is that slight dorsal to anal juxtaposition difference. Certainly Dr. Myers thought so when he advised Innes to label *filamentosum* as "*gardneri*" in the latter's book. The original description of *filamentosum* was a bit hazy or else it was based only upon a single specimen.

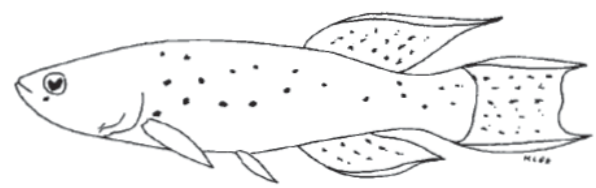


FIG. 4 - Drawing of *Aphyosemion gardneri* from Boulenger's original description.

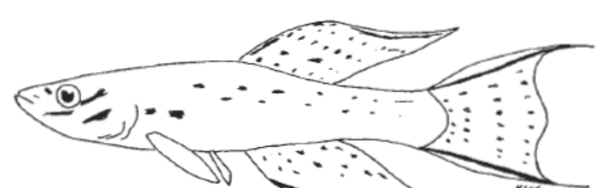


FIG. 5 - Drawing of *Aphyosemion arnoldi* from Boulenger's original description.

However, these are matters to be decided by the ichthyologists with, I hope, the help of the AKA. The more preserved specimens of all of these "species" we can collect, the faster we will know for sure.

Suggested Reading:

"*Aphyosemion gardneri*," by Herman Meinken, *Aquatic Life*, Sept. 1954.
"*Aphyosemion filamentosum*," by Bruce Turner, *Aquarium Journal*, October 1961.
"Care and Breeding of *Aphyosemion filamentosum*," by Dr. Walter Foersch, *Tropical Fish Hobbyist*, December 1959.

Killifish Exchanges Revolutionized!

by Albert J. Klee

Killie Notes Vol. 1, Issue 2, pp. 8-11, 1962

To date, the backbone of killifish exchanges has consisted of egg shipments from one hobbyist to another. Killifish fanciers are located scattered throughout the North American continent (AKA members, that is!) and coupled with the scarcity of species locally, these conditions have spurred the widely accepted practice of exchange and dissemination of species via egg sendings through the mails.

There are two major problems connected with egg shipments, however. The first is that eggs frequently just do not hatch out properly after being shipped. There are many reasons for this but aside from improper preparation and packaging, eggs are somewhat sensitive to the changes in environment which automatically occur as a consequence of such shipments. The second problem is that for many aquarists, the waiting period between receipt of eggs and growth to maturity of the fishes hatched out, is much too long. This is often ironic since in many instances, breeders have stocks of young fishes on hand which they are willing to part with, but are stymied because of the expense of and the uncertainties with, shipping live fishes via air express or air freight. With the former, delays in delivery are unavoidable and no one cherishes the long trip in the middle of the night to the airport, frequently necessitated by the latter.

In recent months, the author has experimented in shipping fry and young fishes (young breeders) within the continental United States, using the ordinary mail system. After refinement of techniques, the experiments can be deemed an unqualified success and indeed, such shipments are regularly being made by me and my friends throughout the country.

The very first experiment was so successful that it prompted the whole series which followed. This involved the sending of a number of newly-hatched fry of *Epiplatys sexfasciatus* from Cincinnati to New York. A detailed description of this event is to be found in my "Under The Cover Glass" column in the March 1962 issue of the Aquarium Journal, therefore it will not be repeated here. Suffice it to say that the other half of the cooperating partnership. was the Co-Chairman of the New Species Committee, Bruce Turner of Brooklyn, N. Y.

Harvey Siegal, another AKA member living in Brooklyn, has made several shipments to me and I have made some counter-shipments to him. John Gonzales (the other half of the New Species team!) has kept the Philadelphia to New York, and the Philadelphia to Cincinnati routes hopping with fish shipments, also. It is noteworthy to observe that most of these shipments have been made in extremely cold weather but were successful, nevertheless.

There were, to be sure, a few failures. It took us only one shipment to bar the use of rigid plastic containers for holding water. The packages go through some rough handling and rigid containers are likely to split wide open with disastrous results to the fish (and, I suppose, to surrounding mail, as well !) . One shipment went via surface mail instead of the usual airmail. In spite of the special delivery provisions, the water temperature upon arrival was 49°F. The fish in question, of course, arrived dead.

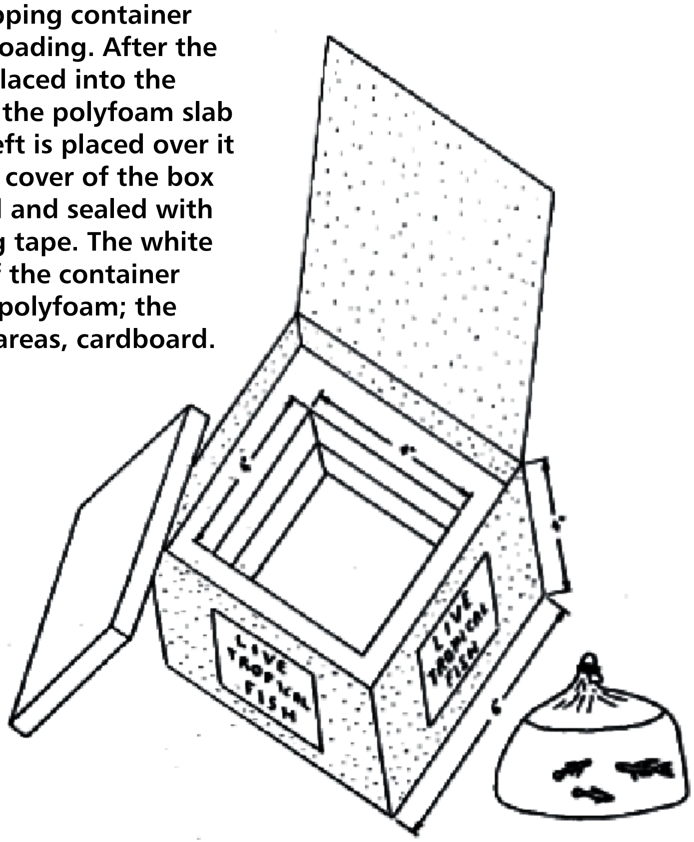
All in all, we have made some remarkable shipments. Perhaps the most stringent test of all was made when the author made a shipment of a trio of *Aphyosemion calliurum ahli* (?) to AKA member Gordon Foster of Imperial Beach, California, and Gordon made a counter shipment of a trio of *Aphyosemion australe* from California to Ohio! The distance involved was about 2300 miles but the airmail special delivery package took but a day. Gordon's package to me arrived the day after Cincinnati had 4 inches of snow on the ground, but all fish were alive. In fact, I bred them a few days later. We found that the water temperature upon arrival was about 63 to 64 °F (initially, of course, it was in the 70's) but killies can take these temperatures easily and suffer no ill effects from the experience.

Now for details of the techniques involved.

1. A trio of young killifish breeders should require no more than 2 ounces of water! The less water, the lower the shipping charges will be.

2. Although a number of shipments were made without the use of a tranquilizer, it is suggested that some kind of tranquilizer be used. This reduces the oxygen demand upon the small amount of water involved. A number of tranquilizers were used, but in the final analysis, Metab-O-Fix (available from your dealer or from Tropicals Research, 1433 N. Dearborn Pkwy., Chicago 10, Ill.) served the purpose well, was effective and easy to use. In 2 ounces of water, one or two drops per fish proved sufficient.

3. The inner container (the one actually containing the fish) should be a plastic bag. These are available from your .dealer and also from *All-Pets Magazine*, P.O. Box 151, Fond du Lac, Wisconsin (6" x 10" - 25 for 50¢ and 7-1/2'' x 10" - 25 for 50¢). For safety's sake, use double bags, one inside the other. Be especially careful in the sealing of the ends of the bag. Twist the end tightly and then bend it over. Place a strong rubber band around the end and then follow up with a piece of adhesive tape around the rubber band. From experience, most difficulties encountered have been a result of slight seepage from improperly tied bags. Wet



The shipping container before loading. After the bag is placed into the hollow, the polyfoam slab at the left is placed over it and the cover of the box lowered and sealed with masking tape. The white areas of the container denote polyfoam; the dotted areas, cardboard.

insulation is poor insulation and even the least bit of seepage is undesirable.

Small fish often find themselves trapped in the corners of the bag and in the process of trying to get back into the main body of water, frequently die in the attempt. Tie off the two bottom corners of the bag with small rubber bands before adding the fish.

Most participants in these exchanges used a double container, that is to say that the plastic bag was placed into a small container and this then placed into a larger box (the outer container). The space between the boxes was filled with shredded newspaper for insulation. For my own shipments, however, I have devised a lightweight, permanent shipping container. Procure a 1" x 12" x 12" piece of polystyrene or polyurethane foam (this is the material from which many Christmas decorations are made). Cut it into four equally-sized squares, 1" x 6" x 6", and stack them on top of each other, forming a sort of block. If a square, 4" x 4", is cut from each of the two middle pieces, a hollow space will be formed in the middle of the block. This leaves 1" of insulation all the way around and a space for the plastic bag of 4" x 4" x 2." One can "build" a cardboard box around the insulation using masking tape to hold it together. The whole structure, due to the polyfoam, is quite rigid and sturdy. In shipping, the fish are placed in the plastic bag in the hollow, the top square of insulation fitted over this, and lastly, the top of the cardboard box is taped on over. After addressing, the container is ready to go. Recipients are requested to mail the box back by surface mail.

4. If you desire, the cardboard box can be wrapped in brown paper and then addressed. A large tag bearing the legend, "LIVE TROPICAL FISH," should also be added. Forget about legends cautioning about "Keep warm," etc… these are just a waste of time. However, if the recipient should not be at home when the package is delivered, the "LIVE TROPICAL FISH" will prompt the postman to return the box to the post office instead of leaving it on a cold doorstep.

5. Take the box down to the post office and have it sent airmail, special delivery. My California shipments, using the lightweight box described, cost me only $1.35 to send ($1.05 for the airmail and 30c for the special delivery charges). If you spend more than this, your package is too heavy and you are wasting money. My package without fish and water weighs a bit less than 5 ounces. Complete and ready to go it weighs about 13 ounces. In some instances, first class mail may be cheaper than parcel post so let your post office decide for you. Make sure, however, that it goes airmail, special delivery.

6. It helps to forewarn the recipient of a shipment via a postal card. Thus, someone will be at home to receive the fish when they arrive. I personally like to ship on Saturday morning since most people are at home on Sunday evenings when the package usually arrives.

Sending and receiving live killifishes through the mails is quite a bit of fun and once a permanent package is made up and you have mastered your techniques, it is no more trouble than shipping eggs. When the fish are received, they are ready to breed and the process of trying out a new killifish is considerably speeded up.

RACHOVIA SPLENDENS
Imported By The AKA!

by Albert J. Klee

Killie Notes Vol. 1, Issue 4, pp. 12-13 , 1962

The first importation by our New Species Committee recently was completed with the importation of two Columbian annual fishes, *Rachovia splendens* and *Austrofundulus my-*

A *Rachovia splendens* male, one of two species recently imported for AKA members from South America by the New Species Committee. A very rare killifish. Photo by Klee.

ersi. Complete details will be available in the next issue of KN but a quick summary is presented here concerning *Rachovia splendens* so that AKA members may have first opportunity to learn something about this rare fish. This is the fir t time this species has been used as an aquarium fish and indeed, the fish is rare even among ichthyologists. The following are a few brief remarks made upon observing several fish in the aquarium.

The male is a very gorgeous fish. Its body coloration is very similar to that of *Nothobranchius rachovii* (the familiar herringbone pattern) except where the latter alternates blue and red, *R. splendens* alternates green and red. The caudal fin is a riot of colors and sports many colored margin. The posterior end of the tail is edged in black and is backed up on the inside with a line of orange-yellow. The upper and lower edges of this fin are colored a burnt orange, and these too are backed up with lines along side, this time, however, with a brighter yellow. The general interior of the fin is covered with brilliant blue spots. The anal fin is edged with burnt orange and it has yellow, orange and blue spots in more or less of a regular pattern in the interior. The fin is almost solid electric blue near the body. The dorsal fin has a very regular pattern of burnt orange spots separated by yellow-green color, and the fin is also edged in burnt orange. The ventral fins have bluish markings.

Females, on the other hand, are almost without color although their anal fins have a bluish tinge, and there is a faint suggestion of the herringbone pattern on the sides. In general, however, the impression is that of a brownish-gray fish. The males have slight extensions on their tail fins whereas the females do not. My females do not exceed 1 inch in length but the males easily exceed l-1/2 inches.

In quick summary, *Rachovia splendens* is reminiscent of a chunky *Pterolebias* with *Nothobranchius rachovii* type markings. The fish appears to be easy to breed as they were observed laying eggs in a dish of peat within three days after I received them. However, details of their breeding will have to wait for the time being. They apparently (like most annuals) are not fussy about water conditions since the spawning is taking place in water of hardness 200 ppm, and pH of 7.2. All in all, a very interesting importation by the New Species Committee.

MALES vs. FEMALES, A TEST

by Albert J. Klee

Killie Notes Vol. 1, Issue 5, pp. 18-20, 1962

Many killifish fanciers have been concerned lately with the problem of unequal sex distribution in batches of killifish fry. In other words, such broods turn out to be mostly females or mostly males and are, of course, most disappointing to the breeder. Unequal distributions arise from two sources:

(1) non-chance events and

(2) chance occurrences.

Under the first category, many interesting theories have been advanced and suspected factors certainly include temperature, pH and the moisture content of the incubation medium (the last-named in the case of the soil breeders). It is not, however, intended to discuss these factors here. The second category subjects all knowledge of uncertainties. We may flip a fair coin 1000 times, for example, and obtain 466 heads and 534 tails. We expect to get 500 heads and 500 tails but chance steps in and alters our expected ratio or, more precisely, gives us a resultant ratio which differs from the mathematically expected ratio. Certainly the 466 to 534 ratio would excite no one! It is, so to speak, "to be expected."

Let us carry the analogy a bit further now. We really aren't surprised to discover unequal sex ratios appearing from time to time with our fishes since the laws of probability practically guarantee such occurrences. But intuitively, at least, aquarists begin to "draw the line" when the ratios become too unbalanced. In order to provide a quantitative basis for deciding when the ratio is "too unbalanced," i.e., when the chance effects become overshadowed by the non-chance events, we present a simple test as follows.

Calculate z in the formula, $(2y-n)/\sqrt{n} = z$

where n is the total number of fish (both males and females) in the brood, and y is the number of males or females, whichever is larger. Note that this test works well only for n equal or greater than 15 fish.

Next, evaluate z by means of the following table:

z	Probability of the number of males (females) exceeding y
0.25	40% or 40 chances out of 100
0.50	31 o/o or 31 chances out of 100
0.75	23% or 23 chances out of 100
1.00	16% or 16 chances out of 100
1.25	11 % or 11 chances out of 100
1.50	7% or 7 chances out of 100
1.75	4% or 4 chances out of 100
2.00	2% or 2 chances out of 100
2.25	1 % or 1 chance out of 100
2.75	0.5% or 5 chances out of 1000
3.00	0.1 % or 1 chance out of 1000
3.50	0.02% or 2 chances out of 10,000
4.00	0.004% or 4 chances out of 100,000

The point at which one begins to doubt that a given unbalanced sex ratio is due merely to chance is somewhat a matter of individual preference. For example, in z = 1.75, there are 4 chances out of 100 for obtaining such a ratio. Most people would not be too surprised if a horse with these odds against it won a race, but would be amazed if it won when the odds were 4 out of 100,000 (z= 4.00)!

Let's consider some examples:

Example #1: An aquarist discovers that, out of a batch of Aphyosemion australe totaling 59, 35 are males and 24 are females. Are factors such as pH, temperature, etc., to be suspected for this unusual sex ratio?

In this case, $z = \frac{2(35) - 59}{\sqrt{59}} - \frac{11}{7.68} = 1.43$

Such an event would be expected to occur somewhere between 7 and 11 times per hundred and therefore is not to be thought unusual. In my opinion, temperature and pH are not really worth investigating in this instance. Example #2: An aquarist finds that 76 out of 110 Aphyosemion gulare coeruleum are females, the rest males. We ask the same question.

$$z = \frac{2(76) - 110}{\sqrt{110}} - \frac{42}{10.5} = 4.00$$

In this case, the imbalance is not likely due to chance and the other factors definitely need investigation. The number, z, would only be expected to exceed 4.00, 4 times out of 100,000.

Example #3: This time, it is 19 male Nothob*ranchius palmquisti* out of a total of 35 fishes. Again, we ask the same question.

$$z = \frac{2(19) - 35}{\sqrt{35}} - \frac{3}{5.92} = 0.51$$

This is clearly a chance imbalance and it would be a waste of time to investigate other factors on this account.

A DIRGE For THE PASSING OF PANCHAX

by Albert J. Klee

Killie Notes Vol. 1, Issue 6, pp. 6-8, 1962

In the very first issue of KN (see KN, February 1962) we presented several reasons for the Association's replacement of the term "killifish" for the perennial and popular, "panchax." Aquarists, however, have never had, hitherto, the opportunity to learn why Science decided that the latter was not a validly used generic name and why it was dropped from the rolls of acceptable ichthyological nomenclature. There are tales more easily told than this one, to be sure, but some of our more hardy members who have learned to take the bitter with the sweet may be interested in this story, grown over through the years with the cobwebs of neglect. Much of the credit for the unraveling of this mystery rightly goes to Dr. Hugh M. Smith, author of the famous, "The Freshwater Fishes of Siam, or Thailand."

Nowadays, when an ichthyologist describes a new genus, it is necessary to specify a particular species as the type for the genus. This is referred to as the "type species." The Rules of the nomenclatural game adhered to by professionals state that, regardless of the other member species of the genus, the generic name goes with the type species like Damon with Pythias of Greek mythology. In the early days of ichthyology, however, it was not considered necessary by many ichthyologists to name a type species for a new genus. It was later realized that this was going to lead to quite a bit of nomenclatural confusion and it became necessary to designate type species for genera which had none.

Our story starts when the genus *Aplocheilus* (pronounced AP'-LOW-KYLE"-US) was established by the ichthyologist, McClelland, in 1839. McClelland placed three fishes in the genus at that time, two of which were newly-described· by him. These fishes were: *Aplocheilus chrysostigmus, A. melastigmus* and *A. panchax*. The last-named species was first described as Esox panchax by Hamilton in 1822 and did not really belong in that genus or anywhere near it. McClelland failed to name a type species for his new genus and since it later turned out to be composite (i.e., actually comprising two distinct genera), his oversight paved the way for considerable confusion, a bit of which has been shared by killifish fanciers.

Chronologically, the next action was taken by Valenciennes (in Cuvier and Valenciennes) when in 1846, ignoring McClelland's *Aplocheilus*, he established the genus *Panchax* containing four species. Among the species included were *Panchax buchanani* and *Panchax pictum*. However, *Panchax buchanani* was a synonym for Hamilton's *Esox panchax* (Valenciennes renamed it), and *Panchax pictum* really belonged in the genus *Betta* (*Betta picta*)! Nevertheless, *Panchax* was widely accepted and used, as aquarists very well know.

The Dutch ichthyologist, Bleeker, was the first one to designate a type species for McClelland's *Aplocheilus*. In 1863, he named *Aplocheilus chrysostigmus* as the type species in his synopsis of the genera of killifishes. In so doing, Bleeker committed a bit of a booboo as this was actually directly opposite to what he had intended to do for *A. chrysostigmus* is a synonym of *A. panchax* and Bleeker, in the same synopsis, placed *A. panchax* in the genus *Panchax*. There is good reason to believe that he had intended to name *melastigmus* as the type species but under the impression that *melastigmus* was a synonym of *chrysostigmus*, he used the latter name instead. Confusing, isn't it? But the damage was done and the genus *Aplocheilus* henceforth had to be associated with the species *panchax* (equals *chrysostigmus*). Since *Aplocheilus* predates *Panchax* by seven years, the correct genus for *panchax* and related species (*lineatus*, *blockii*, etc.) has to be *Aplocheilus* by the Law of Priority (a law which any citizen should be familiar with since it applies to queues, waiting lines, supermarket checkout counters, etc. !). Jesting aside, the Law of Priority is one of a set of formal rules which taxonomic ichthyologists are expected to follow.

In order not to leave any loose ends, we should mention that in 1906, the ichthyologists, Jordan and Snyder, established the genus *Oryzias* for the Japanese cyprinodont then known as *Poecilia latipes*. This genus was snubbed by other ichthyologists for many years for they considered *Oryzias* to be merely a synonym for *Aplocheilus*. Later, however, it was accepted as a valid genus (in which we now place the medaka and related fishes). Since McClelland's *melastigmus* was really related to *latipes*, it was ultimately transferred to *Oryzias*.

Thus for years, aquarists had known two genera; *Panchax* and *Aplocheilus*. When all the evidence was in, species in *Panchax* were transferred to *Aplocheilus*, species in *Aplocheilus* were transferred to *Oryzias* and *Panchax* was discarded. The whole business resembled an ichthyological version of musical chairs!

As hobbyists, it is interesting to note what the situation now would be had Bleeker named *melastigmus* as the type species for *Aplocheilus* as it is thought he had intended. If he had done this, all fishes now called *Oryzias* would be placed in *Aplocheilus*, leaving *Panchax* open to accommodate *p*anchax et al., and leaving *Oryzias*, the newcomer, vacant.

If you have read this far, then mourn with us the passing of *Panchax*, one of the nicest, most easily pronounced scientific names ever encountered in the history of our hobby.

THE CHRISTYI-COGNATUM PROBLEM REVISITED

by Albert J. Klee

Killie Notes Vol. 2, Issue 1, pp. 8-12, 1963

In the April 1962 issue of the *Aquarium Journal*,[1] an attempt was made to shed some light on the confusion that existed surrounding what was shown to be mostly synonyms for *Aphyosemion christyi*. One important revelation in this article appearing in the *Journal* was that the term, "*Aphyosemion schoutedeni*," was a synonym for *Aphyosemion christyi* and that consequently, "*A. schoutedeni*" was not a valid name for aquarists to use. It was also suggested that many fishes being referred to as *Aphyosemion cognatum* were really not that fish at all but *A. christyi*. It is the differences between these two species that I would now like to explore in some detail. Much of what follows could not be presented here were it not for the generous qualities of my friend from Belgium, Mon. Jacque Lambert. "Jack" is an amateur ichthyologist of professional caliber, who has studied under the tutelage of Dr. Max Poll, one of the World's foremost authorities on African fishes. Moreover, he (Lambert) has traveled the Congo Basin many times over, collecting specimens for scientific study. He has a reputation for careful and judicious work and

Aphyosemion cognatum
1. The red dots are more numerous and more evenly distributed on the body.
2. The prolonged rays of the tail fin are much shorter.
3. The body is quite reddish and towards the rear of the body, there is even a reddish shine between the red dots.

Aphyosemion christyi
1. Some individuals may also have numerous red dots but then they are not so evenly distributed.
2. The prolonged rays are often quite long.
3. There is always a blue tinge on the hindmost part Of the body.

among the fishes named by him or in conjunction with Dr. Poll are: *Phenacogrammus polli, Barbus amanpoae, Clarias centralis* and *Hypsopanchax silvestris*. For those AKA members reading French, one of his important papers pertaining to the *christyi* problem is listed in the reference at the end of this article.[2]

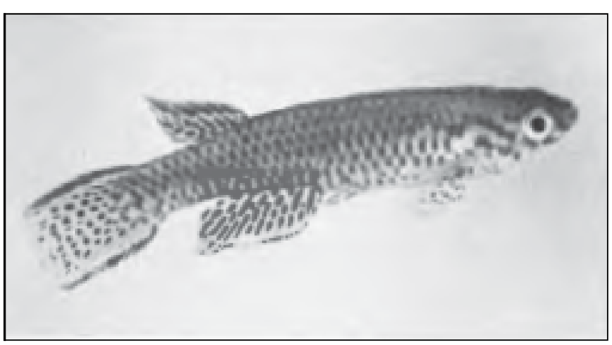
For an aquarist, there are three basic differences between *Aphyosemion christyi* and *Aphyosemion cognatum*, and these are summarized as follows (the accompanying photograph shows typical examples of the two species):

Generally (but not always), *Aphyosemion cognatum* is more plumpish in the body but this depends greatly also upon feeding, condition, etc. so that no great emphasis can be placed upon it.
Although hybridization between these two species does not occur in Nature, aquarists have crossed them many times. As might be expected then, considerable confusion has arisen in certain instances as to the identification of particular fishes.

In August of 1961 I became interested in the use of electrophoresis techniques in the identification of fishes (this came about as a result of an article which appeared in Science Magazine[3]). Electrophoresis is a technique whereby high voltages are applied to, for example, a strip of filter paper containing some usually highly complicated organic extracts such as muscle protein. As a consequence of these high voltages, the different components of the extract migrate at different velocities, producing a series of bands.

These bands are then brought out strikingly when stained with a dye specific only to proteins. Seven typical such bands are shown in Figure 3 (about which, more will be said later on). Evidence has been presented to suggest that such bands from groups of fish muscle proteins may "fingerprint" the species in question. Coincidentally, and at about the same time, Dick Lugenbeel also became interested in this new technique.

Unfortunately, due to the high cost of electrophoresis equipment, neither Dick nor myself were able to experiment directly but a friend of Dick's, Dr. Richard Hewitt of the Carnegie Institution of Washington, was able to study at least 7 different *cognatum-christyi* types



Left - *Aphyosemion cognatum*; right - *Aphyosemion christyi*. Photos by A. J. Klee.

provided by Dick (the results of which are actually shown in Figure 3). Furthermore, Dick sent me color slides of 4 of the 7 fish analyzed (numbers 3, 4, 5 and 7 on the figure) plus a pair of fish from a strain represented on the tracings (number 7). Somewhat later, Ed Seligmann sent me a king-sized live shipment of cognatum-christyi types, two of which were represented on the figure. It is a happy commentary here to make when we observe that generous nature of two outstanding aquarists, truly interested in the hobby and its advancement, without any thought given to personal gain or aggrandizement. Much of the credit for the solution of the problems presented here rightly goes to Dick and Ed.

An examination of the protein bands shows one to be particularly aberrant. This is band number 3, obtained from a fish originally sent to Franz Werner (another fine aquarist) by the world-renowned collector and Honorary AKA member, E. Roloff. Fortunately, this was one of the live fishes sent to me by Ed. The other fish represented on the protein bands that was received from Ed was fish number 4.

Armed with the tracings, color slides and preserved fishes (it broke my heart but Ed's and Dick's fish went into the formalin jar!), I prepared the material for examination by Jacques Lambert. Within a short time, word was received back from him and his conclusions are briefly summarized as follows:

1.The fish represented by band number 3 was a true *cognatum*.
2. The fishes represented by bands number 4, 5 and 7 were true *christyi*.
Not all of the tracings were represented by color slides and/ or preserved specimens and since ichthyologically speaking, many measurements of *christyi* and *cognatum* overlap each other making it difficult to draw conclusions from a single specimen, a good many questions remain unanswered but nevertheless, when color slides and/or preserved material were available, the electrophoretic protein bands did not contradict the conclusions already reached. Its own pro-

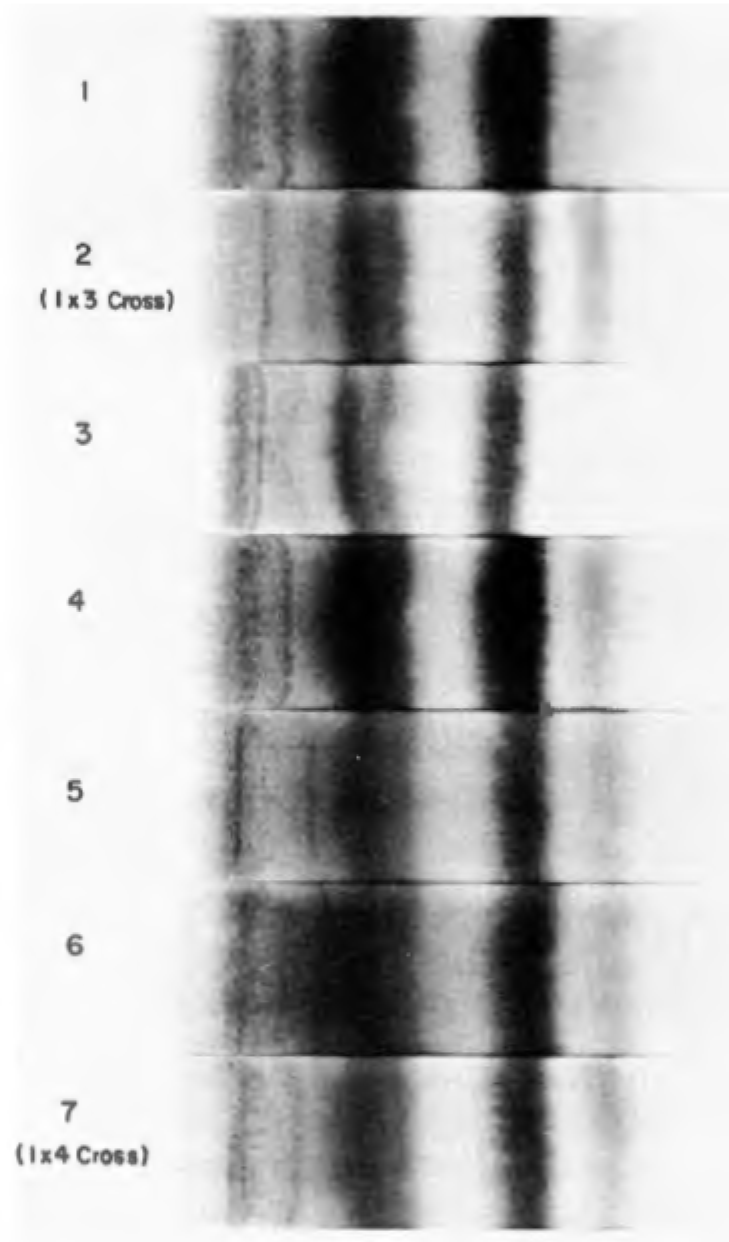


Figure 3: Protein bands of 7 christyi-cognatum types . Photo by Dr. Richard Hewitt.

tein band fingerprints the true *cognatum* in the fine tradition of the FBI, the fingerprints for *christyi* being just as incriminating! Perhaps we may see more use made of this technique in the future. As a matter of fact, Joergen Scheel (Honorary AKA member) has informed me that a Danish scientist friend of his is going to use this technique for analyzing the affinities among various West African killies.

Jacques Lambert has this interesting remark about the christyi pictured in Dick's slides: **"I will add, as a general comment, that none of your *christyi* have the exact appearance of the typical form, i.e., of the fishes from the vicinity of Stanleyville (Boulenger's types having been described from the River Lindi). In these types (and topotypes), the pectoral fin bears a continuous carmine border followed by a broad, yellow one. In your fishes, as far as one can judge from the pictures, the pectorals are indeed broadly yellow, but either lacking the carmine altogether or else bearing only separate spots of it (i.e., "mottled"). However, some specimens of *christyi* originating farther south do show these separate spots indeed. As I said before, the species inhabits a very big area and shows much natural variability from one population to another."**

In conclusion, it should be mentioned that there is a possibility that both *Aphyosemion lujae* and *Aphyosemion elegans* are also synonyms for *A. christyi*, but the evidence is not conclusive at this time. If *lujae* and *christyi* are ultimately shown to be one and the same species, then the correct name would be *lujae* on the basis of priority. In the meantime, *christyi* is the proper term to use. It is realized that there is some confusion over the name, "*lujae*," as a result of an article appearing in the February 1961 issue of the Aquarium Journal.[4] The fish described is not *Aphyosemion lujae* and I hope to be able to discuss this problem in a future issue of KN. Finally, a recent examination of Ahl's type specimens of *Aphyosemion congicum* by Dr. Radda of Hygiene-Institut der Universitat Wien, has led Dr. Radda to conclude that even this fish should be added to the synonyms of *Aphyosemion christyi*.

ACKNOWLEDGMENT:
In addition to expressing my thanks to Messrs. Lambert, Lugenbeel and Seligmann, I am indebted to Dr. Hewitt of the Carnegie Institution for permission to present a portion of his work here.

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3. Lillevik, H.a. and C. L. Schloemer, "Species differentiation in fish by electrophoretic analyses of skeletal muscle protein," *Science*, Vol. 134, August 16, 1961.
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The Most Peculiar Killie

by Albert J. Klee

Killie Notes Vol. 2, Issue 2, pp. 17-20, 1963

My candidate for the title of "Most Peculiar Killie" was introduced to the world in the "Tropical Fish Magazine (1), a joint publication venture (now defunct) of some 30 or so aquarium societies during the middle 1950's. Considering that the killie in question, *Pantanodon podoxys* (pronounced PAN-TAN'-O-DON PO-DOX'- SIS), represented not only a new species but a new genus and subfamily as well, this was truly unusual! It meant that hobbyists were among the first to learn of this radically new fish. Our distinguished Honorary Member (see his article in

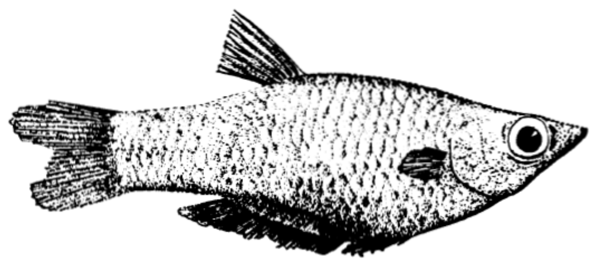

Figure 1: *Pantanodon podoxys* male (fins damaged).

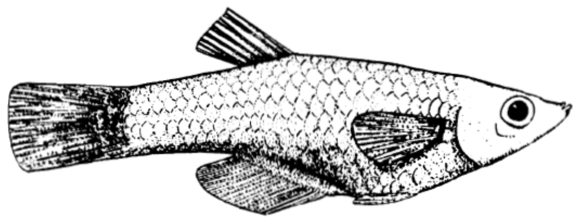

Figure 2: *Pantanodon podoxys* female.

this issue of KN), Dr. George S. Myers, wrote the article. In a personal note last year, Dr. Myers kindly informed me of the rediscovery of *Pantanodon* and the work of Dr. P. J. Whitehead of the British Museum. Dr. Whitehead's work is now completed (2), and due to the many unique features of this killie and the fact that several were imported into the New York area recently, it appears profitable to bring a number of his findings to the attention of AKA members.

Dr. Myers' two specimens were captured in Tanganyika in "swampy land a few miles inland from Dares Salaam." Dr. Whitehead's five specimens, on the other hand, were taken in Kenya from one of the many typical, salt-evaporating pools found there. These pools are near enough to the sea to be flooded by salt water at high tide. As a matter of fact, co-inhabitants of this pool with *Pantanodon* were several marine fishes, and *Tilapia mossambica*, the latter a species well noted for its tolerance to salt. The salinity measured 40,000 ppm and in light of the fact that about 37,000 ppm is considered average for marine water, this is salty indeed!

The length of these specimens ranged from 3/4" (Kenya females) to 1-¼" (a Tanganyika male). Unfortunately, there are no records of life colors but preserved specimens are a uniform light-brown with scattered black spots on head and lips. Superficially, *Pantanodon* resembles a livebearer more than a killie (see figures 1 and 2) although it is reminiscent of certain lampeyes, notably *Hypsopanchax* (KN hopes to be able to report upon the genus *Hypsopanchax* in a future issue .... members of the genus have been imported as aquarium fishes recently).

One of the first oddities associated with *Pantanodon* is the absence of jaw teeth (hence the name, *Pantanodon* = "without teeth whatsoever"), this alone making it unique in the family of killies. This is not really a handicap for there is evidence to suggest that this fish is a "filter feeder," i.e., they subsist by drawing in water to their gills, subsequently removing the microorganisms contained therein. When Dr. Whitehead first examined the gillrakers of this tiny fish, they appeared as thin rods ... nothing unusual there.

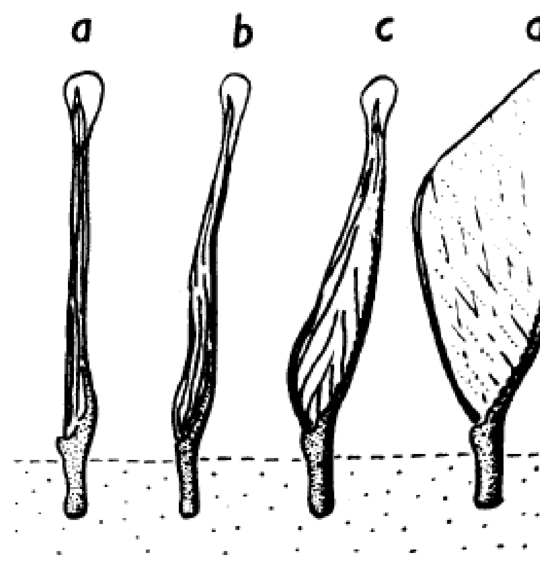

Figure 3: Gillrakers in ascending degree of expansion from a to d .

However, when he removed the gillrakers, placed them on a microscope slide in glycerin and subjected them to slight pressure, they expanded into minute triangular fans (figure 3). It appears that these fans act either (a) as a sieve filter capable of removing very tiny particles or (b) a mucous bearer to which such particles adhere. Since the sieve filter is better adapted to larger fishes, it is probable that *Pantanodon* has a plate filter of the latter type. To further reinforce the idea that *Pantanodon* is a feeder upon diatoms and other microorganisms, we find that it has a very long and much coiled gut (typical of "grazing" fishes). The type of coiling allows for a maximum gut length for a given volume of body cavity.

The specific name of *Pantanodon is podoxys* (equals "sharp foot"), referring to The sharp spine of the ventral fins of the male. Male fishes also have another peculiar characteristic in that they possess pectoral fins with hooked ray tips (see figure 4). This also is unique among killifishes. Perhaps this structure is connected with breeding behavior in some way.

Pantanodon, although it appears to have close affinities with the lampeyes (*Micropanchax, Aplocheilichthys, Procatopus*, etc.), is a highly specialized genus that, for the present at least, would appear to merit its own subfamily, *Pantanodontinae* (pronounced, PAN-TANO-DON'-TIN-NEE). When and if aquarists generally obtain more live specimens of this fish, they will no doubt have their work cut out for themselves, both in the feeding and the breeding problems involved. Yes, *Pantanodon* is truly a peculiar killie it's my nominee, what's yours?

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A HISTORY OF AQUARIUM KILLIFISHES

by Albert J. Klee

Killie Notes Vol. 2, Issue 3, pp. 6-9, 1963

Data concerning the chronological acquisition of killifishes in this country is almost nonexistent unless we take as our starting point, the post-World War II years. Much the same can be said for all other countries with the single exception of Germany. The reasons

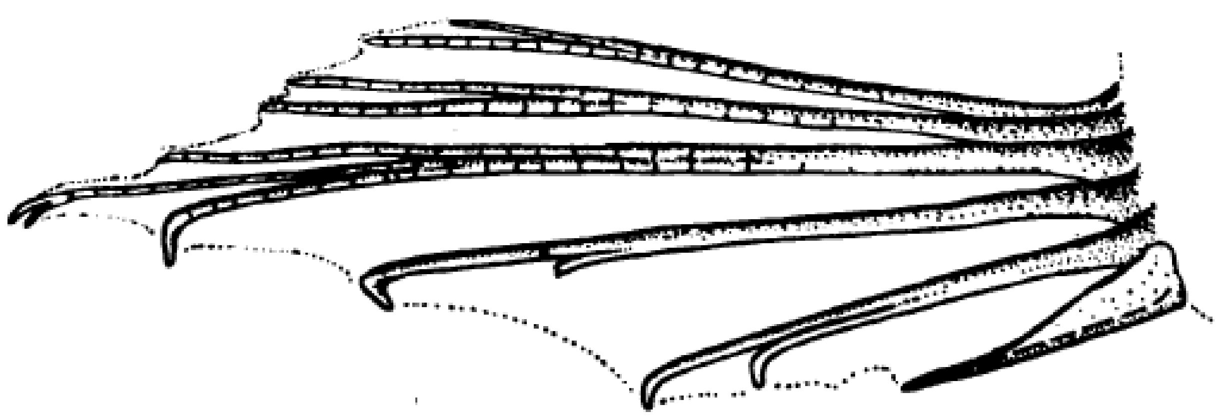

Figure 4: The ventral fin of *Pantanodon*, showing its hooked ray tips. (All sketches after Whitehead.)

TABLE I: Chronology of Killifish Importations Into Germany Prior to World War II.

Before 1900	
1881	Valencia hispanica
1890	Fundulus majalis
1895	Oryzias latipes
1899	Aplocheilus panchax
1900 to 1909	
1903	Rivulus santensis
1904	Pachypanchax playfairii
	Aphanius dispar
	Fundulus chrysotus
	Fundulus notti
	Micropanchax schoelleri
1905	Rivulus urophthalmus
	Fundulus catenatus
	Fundulus diaphanus
	Aphyosemion arnoldi
	Cyprinodon variegatus
	Epiplatys sexfasciatus
	Aphyosemion coeruleum
1906	Fundulus heteroclitus
	Rivulus ocellatus
	Aplocheilichthys spilauchen
	Rachovia brevis
	Cynolebias bellottii
1907	Aphyosemion gulare
	Fundulus grandis
1908	Aphyosemion loennbergi
	Aphyosemion liberiensis
	Aphyosemion gardneri
	Aphyosemion calliurum
	Aphyosemion bivittatum
	Epiplatys chaperi
	Epiplatys longiventralis
	Cynolebias nigripinnis
1909	Rivulus isthmensis
	Aplocheilus lineatus
	Aphyosemion sjoestedti
	Rivulus tenuis
1910 to 1919	
1910	Fundulus cingulatus
	Epiplatys grahami
	Rivulus strigatus
	Aphanius sophiae
	Micropanchax macurus
	Cynolebias wolterstorffi
	Orizias javanicus
	Orizias melastigma
	Epiplatys senegalensis
1911	Fundulus notatus
	Aphanius iberus
	Epiplatys fasciolatus
	Epiplatys macrostigma
	Aphyosemion bitaeniatum
1912	Cynolebias melanotaenia
	Oryzias celebensis
	Cynolebias elongatus
1913	Aphyosemion australe
	Aphyosemion cameronense
	Aphanius fasciatus
	Nothobranchius guentheri
1914	Jordanella floridae
1920 to 1929	
1921	Cynolebias adloffi
1923	Rivulus dorni
1924	Rivulus xanthonotus
	Leptolucania ommata
1925	Nothobranchius rachovii
1926	Micropanchax macrophthalmus
	Nothobranchius orthonotus
1927	Rivulus hartii
	Aphyosemion vexillifer
1928	Epiplatys ornatus
	Lucania goodei
	Aphyosemion multicolor
	Aphyosemion oeseri
1929	Aphyosemion splendopleuris
	Micropanchax flavipinnis
	Rivulus cylindraceus
1930 to 1939	
1930	Pterolebias longipinnis
	Aphyosemion fallax
	Aphyosemion meinkeni
1931	Fundulus sciadicus
	Aphyosemion filamentosum*
1932	Profundulus punctatus
	Cubanichthys cubensis
	Aplocheilus dayi
	Aphyosemion rubrostictum
1933	Cynolebias schreitmuelleri
1935	Epiplatys dorsalis
	Aphyosemion calabaricum
1936	Aphyosemion roloffi
1937	Micropanchax katangae
	Epiplatys nigromarginatus
1938	Rivulus roloffi
	Kosswigichthys asquamatus

*There is evidence to suggest that this fish was imported prior to 1923.

Data for this table was taken mainly from the following texts:

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(3) "Katalog der Vereinigten Zierfischzüchterein," 1922/1923.

TABLE II: Dates of Initial Importations of Important Killifish Genera Into Germany

1890 First Fundulus (F. majalis)
1895 First Oryzias O.latipes)
1899 First Aplocheilus (A. panchax)
1903 First Rivulus (R. santensis)
1904 First Micropanchax (M. schoelleri)
1904 First Pachypanchax (P. playfairii)
1905 First Aphyosemion Ä(A. coeruleum)
1905 First Epiplatys (E. sexfa sciatus)
1906 First Aplocheilichthys (A. spilauchen)
1906 First Cynolebias (C. bellottii)
1913 First Nothobranchius (N. guentheri)
1930 First Peterolebias (P. longipinnis)

for this situation in our own country are not hard to find. Prior to World War II there existed but a single American work that merited the appellation, "reference book," i.e., Innes' "Exotic Aquarium Fishes." All others, regardless of isolated merits here called, and not without some justification, the fish "bible" for American aquarists. In compiling his catalog of fishes he chose not to imitate the current styles or formats, but rather to devise a new approach, one which still basically has never been improved upon (however, it has been widely copied). Unfortunately, the one weakness of this book was that it failed to include historical information about the fishes it described.

At the same time the first edition appeared, the aquarium hobby in the United States was still in its infancy and few references were available containing such historical data. The situation in Germany was quite different, however. Not only were there numerous books published about aquarium fishes, but the German hobby boasted a number of active periodicals as well. In line with the well-known Teutonic proclivity towards documentation, every new import was duly and quickly written up and reported in print. Thus, the task of the German author was made immeasurably easier. Even to this day, our books fail to list historical information. One must fall back on magazine articles, most of which are deficient in this matter also.

The aquarium hobby was introduced to America mainly via German hobbyists, many of whom migrated to this country. As Germans received new fishes, it wasn't too long before they were sent to friends and hobbyists in America. Thus it would not be far afield for us to discuss the pre-World War II chronology of killifish importations into Germany, the data for which is fairly reliable. Such a list is shown in Table I, the nomenclature having been brought up to date. From this listing, a number of things are made clear. Aquarists frequently wonder why our handbooks include species that few, if any, hobbyists have ever seen. Partly this is a matter of copying, one book listing fishes from a previous one. Then too, there is always pressure to be "complete." For example, the first killifish listed in Table I is *Valencia hispanica* (see figure 1). It is, at 1881, our earliest recorded aquarium killifish. Although it was again imported into Germany during the early 1900's, it has and there, were either introductory booklets or rambling discussions of popular topics in the aquarium hobby. Dr. Innes' book has been not appeared on the aquarium scene since. However, if one were to avoid all information about this fish, then it would be just our luck to see it re-imported in the near future! In addition, aquarists become interested in fishes only when they know something about them and if information is made available about rare fishes, hobbyists may militate for our importers to obtain them.

Some aquarists may be surprised to learn how "old" in the aquarium sense, some of our killies really are. As a partial listing of "firsts" in the importation of important killifish genera, Table II has been prepared.
Of course, the fishes listed in these tables were not necessarily known by these names

at the time. In the early days of our hobby, "*Fundulus*" and "*Haplocheilus*" were common terms. Among those fishes included in the former (besides the fishes we today know under that name) were: *Cubanichthys, Valencia, Nothobranchius, Profundulus*, and *Aphyosemion* (especially members of the subgenus *Fundulopanchax*). Among those fishes included in the latter were: *Aplocheilus, Epiplatys, Pachypanchax, Aphyosemion* (especially members of the subgenus *Aphyosemion and Micropanchax*. Forgotten names such as "*Adinops," "Lebias"* and "*Panchax*" were prevalent in those early days. Anyone doing research nowadays using old texts is haunted by these ghosts!

A KILLIFISH NOVELTY, MEXICAN STYLE

by Albert J. Klee

JAKA Vol. 1, Issue 1, pp. 9-13, 1964

Until it was brought to my attention by Dr. Robert R. Miller, Curator of Fishes at the University of Michigan's Museum of Zoology (and Honorary Member of the AKA), I did not realize that the fish fauna of Mexico was so rich and diverse. This, however, is forcefully illustrated by the fact that Mexico is home to two genera of killifishes that are found in no other country! That the fishes in question are not generally known to killifish fanciers is an intolerable state of affairs and so, through the kindness of Dr. Miller who has consented to make available his notes and illustrations, the following is a brief account of one of these fishes.

In 1956, Dr. Miller described a new genus as well as a new species of killifish, i.e., *Cualac tessellatus* (pronounced KWAH'-LOCK TESSSELL- AY'-TUS). Its type locality is known exactly but we will depart from customary procedure and not mention it here. It is a sorry duty but it must be reported that the reason for so doing is that *Cualac* appears to be a very rare fish found only in one rather restricted locality, and thus subject to the possibility that it may become extinct. In this, the situation is somewhat reminiscent of certain species of North American pupfishes (e.g., *Cyprinodon diabolis*) that inhabit but solitary desert water holes. One or more of these species may already be lost forever and it would be a tragedy for it to happen also to *Cualac*. Furthermore, this is a widespread situation of deep concern to all killifish fanciers as it is, for example, another sorry fact that all killies (i.e., *Cynolebias adloffi, C. wolterstorffi*, etc.) with the exception of *Cynolebias* (*Cynopoecilus*) *melanotaenia*, are slowly becoming extinct in the vicinity of Porto Alegre, Brazil, as a consequence of Man's war against Nature (drainage, mosquito control, etc.). Already, at least one species and a number of races of *Nothobranchius* have become extinct in certain southeastern areas of Africa, mostly because of mosquito control. These however, are topics for another time.

Superficially, *Cualac* is similar to *Cyprinodon* but it is somewhat more slender (especially in the tail root) than is usually found in the latter genus (see figure 1). Males (about 1 ¾ inches in length when adult) of *Cualac tessellatus* are colored as follows:

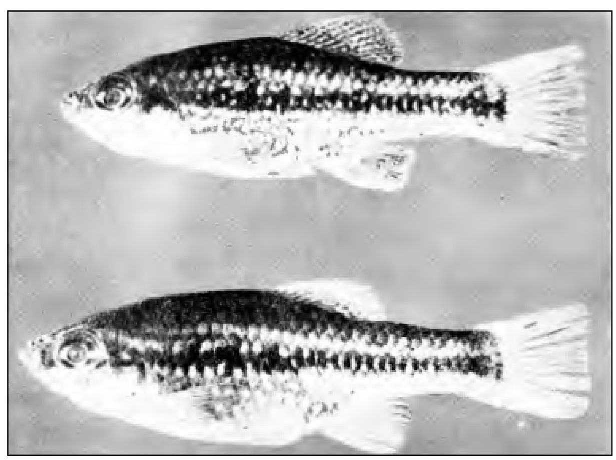

Figure I: *Cualac tessellatus;* male above, female below. Photo courtesy of Dr. Robert R. Miller.

Figure 2: The ditch in which *Cualac* was found. Photo courtesy of Dr. Robert R. Miller.

Non-breeding males- body brownish, ventral area light, whitish-blue chainlike reticulations and spots on sides; a blackish-brown, interrupted lateral stripe; dorsal fin mosiac-like with pale orange edge; anal fin with orange border; pectoral, ventral and tail fins pale yellow.

Breeding males - dorsal and anal fins much blackened, covered with thick mucus and overlaid with orange; tail fin black at base, orange in middle and has black rear edge; pectoral and ventral fins orange; lateral stripe reduced at rear to one to three disconnected, blackish blotches. The differences between the sexes in pattern and color are not great. Males are more colorful when spawning but the differences are not as striking, for example, as those generally found in *Cynolebias* or *Aphyosemion*. Females are larger and have plainer fins, however.

The name, *Cualac*, is derived from a Mexican Indian name meaning, "**where there is good water**," and *tessellatus* is in reference to the mosaic-like pattern of the male's dorsal fin.

Cualac is native to a warm-spring area where the water is very blue and very clear but has a strong odor of sulfur. A typical water analysis is as follows:

temperature	83-87 °F
pH	6.9-7.3
dissolved oxygen	4.0-6.4 ppm
alkalinity	138-158 ppm

The ditch in which *Cualac* was taken (see figure 2) contained a floating, brownish-green algal scum, a green alga over the bottom and sparse water lilies at the margin. This ditch (of slight current) averaged 15 feet wide and 3 to 4 feet deep. The bottom consisted of firm sand, silt and gravel with some rocks. Other fishes found in the vicinity included one species of *Astyanax* and two of *Cichlasoma*. These three species reflected about 90% of the fish specimens collected in the area, while *Cualac* reflected but about 1%.

In a letter to this author, Dr. Miller had this to say about *Cualac* as an aquarium fish: **"*Cualac* is a very striking fish in life but I would suspect that it may not turn out to be a suitable aquarium fish since it probably will be found to behave very much like the genus *Cyprinodon* which, as you know, is a rather belligerent animal."**
Perhaps then, aquarists have not lost much by having *Cualac* unavailable as an aquarium fish but nevertheless, as killifish fanciers it still

Figure 3: General view of area in which *Cualac* was discovered. Photo courtesy of Dr. Robert R. Miller.

seems sad to us that nature has placed it in so precarious a position. Someone with heart has said, "**When a species passes away and is lost forever, the world becomes a little less interesting.**"

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A REVIEW OF THE ELEGANS COMPLEX

by Albert J. Klee, F.A.K.A.

JAKA Vol. 1, Issue 3, pp. 7-14, 1964

The genus *Rivulus* may conveniently be divided into three groups, viz., Breviceps, Marmoratus and Cylindraceous. In addition, it is also useful to further subdivide the last two groups into smaller units called "complexes." This review is concerned with but one complex of the Cylindraceous Group known as the Elegans Complex. One of the prime reasons for examining this complex in detail is to shed some light on the identification of the popular aquarium fish known as the "golden tail rivulus."

The members of the Elegans Complex are species, nine in number, found as far north as Mexico and as far south as Columbia. However, three of them are native to Panama and four to Columbia. Because of the goldentail rivulus problem, the species from Panama are not particularly of immediate interest but one must consider all of the species in order to obtain a complete understanding of the situa-

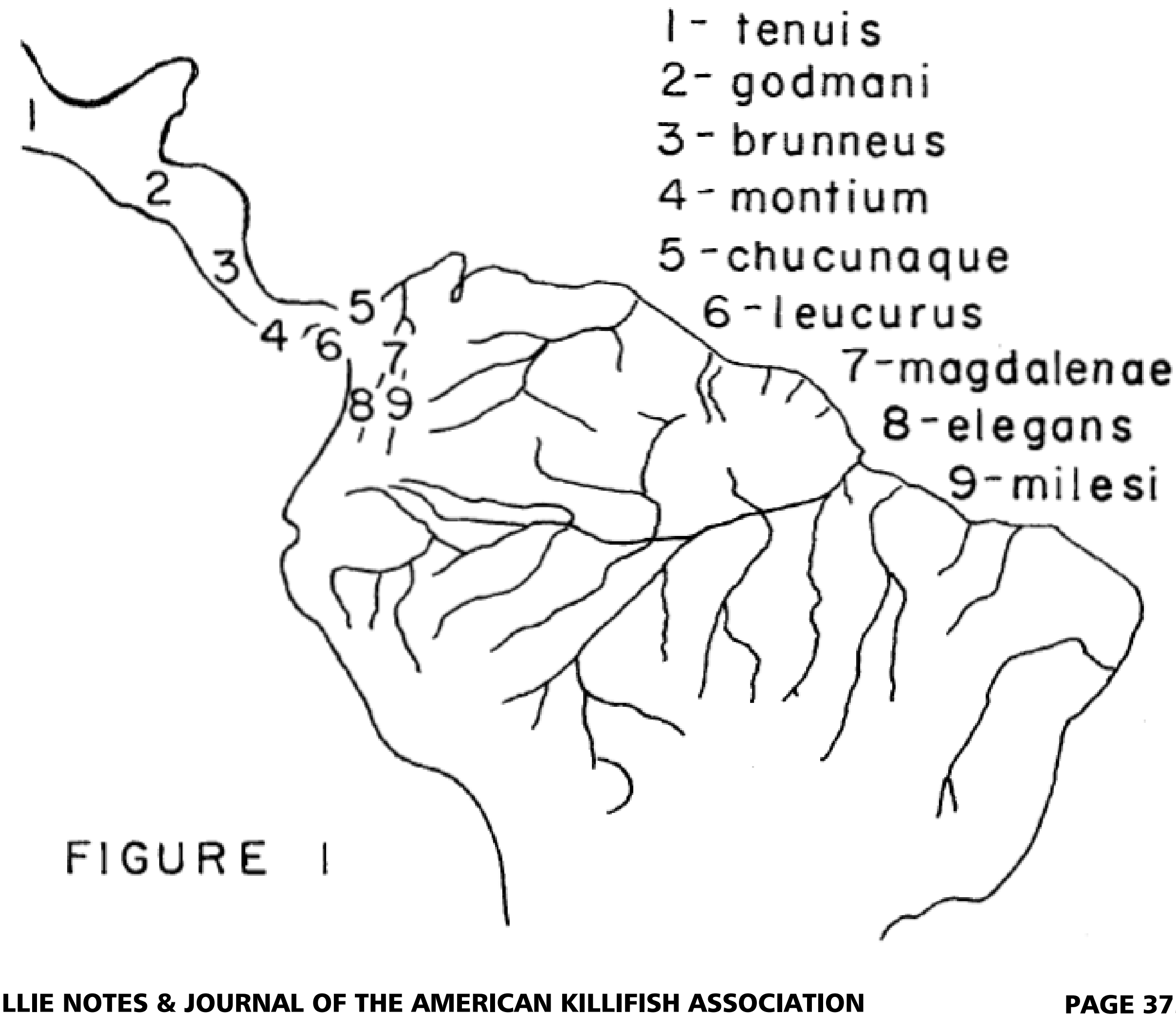

FIGURE 1

tion. Table I lists all species in the complex, together with key counts and measurements, and Figure 1 shows their type localities. I have personally checked all of the original written descriptions in order that the table be as accurate as possible, and have added data from subsequent reports only when I was certain that no confusion existed as to the identity of the species in question. The depth measurement in Table I is expressed in 1000ths of the standard length (i.e., without tail). This way of expressing the depth of a fish may be new to some (it is, in my opinion, the best way to express this measurement). It should be noted that the lower figure for depth is almost always for juvenile specimens (they are, in general, much slimmer) and therefore, a median-to-high figure more fairly represents adult fishes. The number of specimens upon which the data is based is also given and it can be seen that with the single exception of *Rivulus tenuis***,** the data should be quite representative of each species. Finally, I have appended data taken from aquarium specimens of the goldentail rivulus.

Drawings available from the original descriptions (or supplementary works) of the species (with the exception of *R. magdalenae***,** a drawing of which was never made) are presented in Figure 2, but before we start jumping to conclusions, it is advisable to present a concise history of the Elegans Complex. In 1880, Steindachner described *Rivulus elegans* from the Cauca basin in Columbia. Steindachner was dubious about his new species and thought perhaps that it might only be a variant of *Rivulus micropus* (from the Rio Negro, Bra-

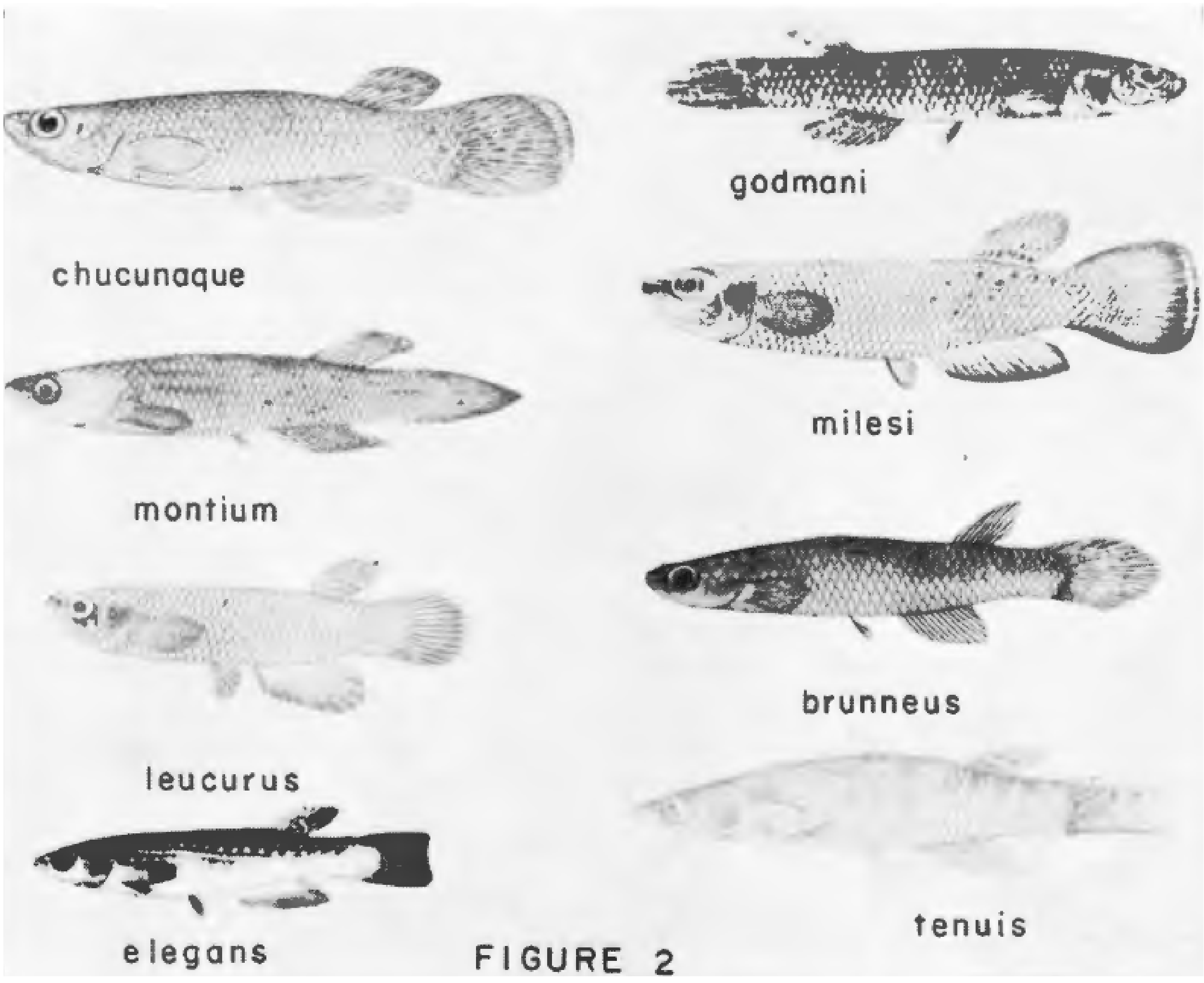

FIGURE 2

zil). R. micropus, by the way, is also in the Cylindraceous Group but in another complex, i.e., the Micropus Complex (which includes the hartii-type fishes... R. elegans does bear some superficial resemblance to *R. hartii*). Garman, in 1895, also believed it to be a form of *R. micropus*. In 1904, Meek described *R. tenuis* from Mexico and in 1906 Koehler described "*Rivulus elegans* var. *santensis*" from Santos, Brazil. But this latter fish is a member of an entirely different group (Marmoratus) and bears no relation to *R. elegans* whatsoever. It is properly known as *Rivulus santensis*.

Then in 1907, Regan described *R. godmani* from Guatemala; in 1913, *R. brunneus* from Panama by Meek and Hildebrand; in 1916, *R. magdalenae* from the Magdalena River in Columbia by Eigenmann & Henn; and in 1925, Breder described *R. chucunaque* (two subspecies) from Panama. A review of the genus was made by Dr. George S. Myers in 1927 in which the suggestion was made that *R. urophthalmus* perhaps intergraded with *R. elegans*. Also, he considered *R. godmani* to be a subspecies of *R. elegans*. In 1938, *R. montium* was described from Panama by Hildebrand; in 1941, *R. milesi* from the Magdalena basin in Columbia by Fowler; and in 1944 *R. leucurus* from the Atrato system in northwestern Columbia, also by Fowler.

During this period, considerable confusion existed regarding the distribution of a number of these species. In 1907, for example, Newton Miller assigned fishes from Los Amates, Guatemala, to *R. elegans*. This was the same year, of course, that Regan considered them to represent a new species, i.e., *R. godmani*. In 1916, Henn commented on two collections of "*elegans*" made by Haseman during 1907-1910. The first collection was taken from the Rio Condoto which is a part of the Cauca system and undoubtedly consisted of true *elegans*. The second collection, however, was from the Rio Truando, a part of the Atrato system and most likely consisted of what Fowler later described as *R. leucurus*. Henn remarked that, **"In none of the specimens from the Rio Condoto is there a caudal ocellus. In the specimens from the Rio Truando almost half of the females possess a distinct caudal fleck and are much darker."**

In Eigenmann and Henn's description of *R. magdalenae*, their type and all paratypes were recorded as coming from the Ibaque area which is in the highlands of the Magdalena basin. Thirty-four additional specimens were recorded from other localities in these highlands (such as the Rio Villeta) but two were recorded from Boquia in the Cauca basin with the comment, **"... probably belong here"**. They probably did not belong there and most likely were *R. elegans*. These two specimens were

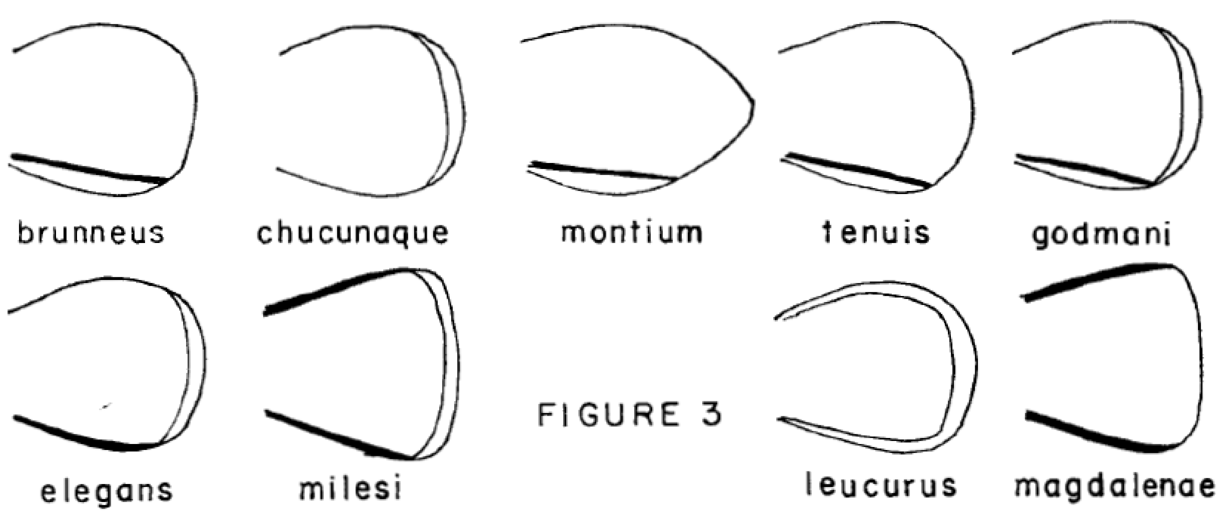

FIGURE 3

not, however, used in the description of *R. magdalenae*.

Fowler's records are even more interesting. In 1941 he described *R. milesi* from Honda, Columbia (Magdalena basin) from specimens collected by Mr. Cecil Miles in 1940. Then in 1943, he placed 13 specimens collected by Brother Niceforo Maria in 1931-1932 from Villavicencio, into "*Rivulus elegans*." His only comment on these specimens was, "They vary considerably in color, the blackish horizontal lines 3 to 6." Then, in 1945, Fowler reported on additional fishes collected by Miles previously in 1940 but this time, the collection was from Villavicencio (in the Rio Meta basin, Orinoco watershed) rather than from Honda. There had been four years delay before the reporting of the Villavicencio specimens. There were two killifishes in this collection and Fowler unhesitatingly labeled them as *R. milesi*. Since the fish of Brother Maria were long in preservative before they were examined by Fowler, and in view of the fact that *elegans* had never been reported from the Magdalena drainage let alone the Rio Meta (Orinoco), I conclude that these fish were either *R. milesi* or *R. magdalenae*, perhaps of a darker variety.

In Columbia, the Andes divides into three separate ranges: the western, central and eastern cordilleras. The eastern and central cordilleras are separated by the relatively broad Magdalena River valley. The western and central cordilleras are separated by the relatively narrow Cauca river valley. In the north, the Cauca system drains into the Magdalena. On the west coast, the northern portion of Columbia is drained by the Atrato river system and in the central portion, by the San Juan River system. East of the eastern cordillera, the area is drained by tributaries of the Orinoco River (see Figure 1). Thus, the Columbian members of the Elegans Complex can be placed geographically as follows:

elegans Cauca and San Juan systems
leucurus Atrato basin
magdalenae - Magdalena basin
milesi - Magdalena and Rio Meta (Orinoco) basins

At this point, it is helpful to consider the tail shape and tail pattern of members of the complex (see Figure 3). We should note that the drawing by Steindachner contradicts his written description of tail shape of *R. elegans*, and that in figure 3, we have used his written description only. Combining Table I, figures 1 and 3, and other geographical considerations,

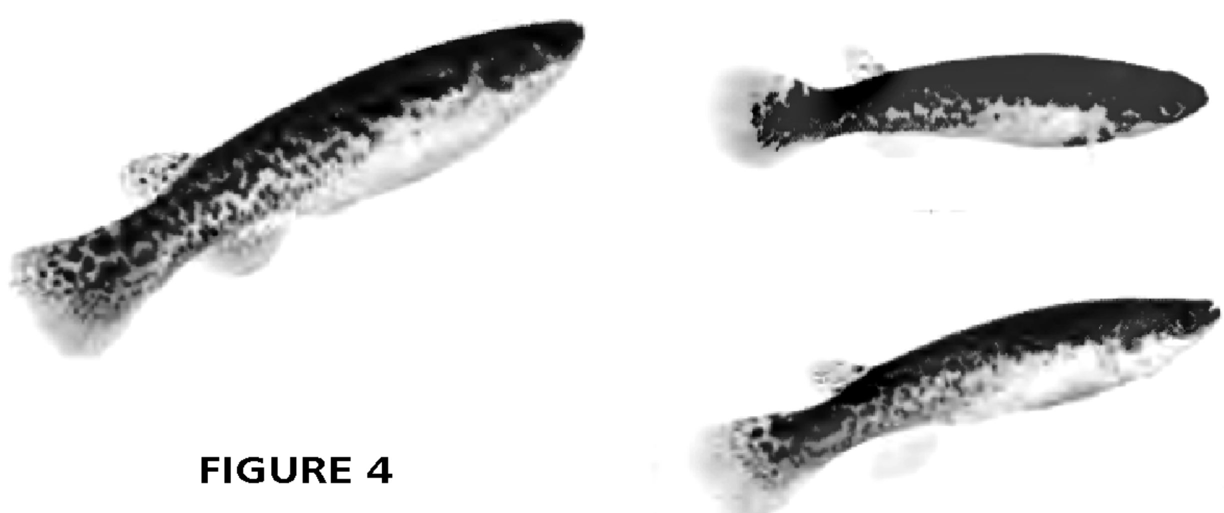

FIGURE 4

we now see the picture clearing up considerably. It is apparent that *brunneus, chucunaque, montium* and *tenuis* form one collection of closely related species, starting with *chucunaque* in the south and progressing to *tenuis* in the north. *R. brunneus* and *R. chucunaque* are separable on the basis of body depth (among other things such as coloration), and *R. montium* via its lanceolate tail. *R. tenuis* is similar to *brunneus* but has a lower dorsal and anal count, and different coloration.

The remainder of the complex (all Columbian except for *R. godmani*) also relate quite nicely, falling into two related assemblages. The first one consists of the broadly-rounded-tail forms of *elegans, leucurus* and *godmani* (progressing from south to north). Here, tail pattern and geography (also coloration) are helpful aids to identification. The second assemblage consists of the subtruncated-tail forms of *magdalenae* and *milesi*. Other than tail pattern (I now quote from Fowler: **"I separated the species (i.e., *R. milesi*) from *R. magdalenae* as the hind caudal edge of the male is conspicuously yellow. In the original account of that species, Eigenmann and Henn have not given any notice of this characteristic, so pronounced in the living fish"**), the greater depth of *milesi* separates it from *magdalenae*. These two species, by the way, are easily separated from the other Columbian species plus *godmani*, via not only tail shape, but counts as well (*milesi* and *magdalenae* tending to be higher).

The pertinent question now is, "What is the goldentail rivulus?" This aquarium fish was originally imported from Villavicencio, which is in the Rio Meta drainage of Columbia. From this discussion, there is no doubt that the goldentail and *R. milesi* are one and the same fish. Some aquarists have equated the goldentail with *R. elegans* and this is not an unreasonable stand by any means. Too little is known about *R. elegans* and too much confusion has surrounded its past history to be parochial about this. However, for the many reasons we have already discussed, if one were to synonomize Fowler's *milesi* with any other species, then *R. magdalenae* would be the logical first choice. Certainly, all of these species are very, very close and quite likely originated in the past from a single species. However, geographical factors have pressed for further speciation. Another possibility is that here is ground for the designation of subspecies, but in any event, some ichthyologist would have to spend some long, hard hours examining types and paratypes (which may or may not be in useable condition).

Another point made by some aquarists is that there are two "goldentails," differing in size (large vs. small), melanophoric coloration (females heavily spotted with large black areas vs. females sparsely spotted with small dots) and tail color (whitish vs. gold). However, we do know that the goldentail is a variable fish. Figure 4, for example, shows three females from the same parents grading from moderate spotting to heavy spotting. This is especially prevalent in the tailfin, caudal ocellus and longitudinal line of spots immediately above the center of the body. If *milesi* is admitted as a synonym for *magdalenae,* then the variability of the goldentail would be even more exaggerated.

Another bit of evidence that indicates that the goldentail is a very variable fish is the fact that the number and size of the characteristic dorsum spots varies even within the same brood of fishes. These are the familiar whitish-green spots on the back of the fish. They are not caused by missing or damaged scales (as I once thought) but are merely scales containing guanine crystals in combination with certain other chromatophores. But it is not to be denied that there are two kinds of goldentails for we know that the original importation and subsequent Villavicencio importations had gold to deep-gold rear tail margins, while the importations from the Villeta-Tocaima-Fusagasuga triangle (located in the Magdalena basin) had whitish margins. It is interesting to note that some of Eigenmann & Henn's specimens of *R. magdalenae* came from the Villeta river. Thus, Fowler found "gold" goldentails at both Honda (Magdalena basin) and Villavicencio (Rio Meta basin) in the form of *milesi*, and "white" goldentails (i.e., his "*elegans*") in Villavicencio, while Eigenmann & Henn found "white" goldentails (i.e., their *R. magdalenae*) in the Rio Villeta and nearby areas west of Bogotá. Finally, our aquarium "gold" goldentails came from Villavicencio, while our "white" goldentails came from Villeta and surrounding areas. Except for coloration, our "gold" and "white" goldentails are in every way, identical.

Our discussion leads us to the following conclusions.

1. There is no doubt whatsoever that Fowler's *Rivulus milesi* and our goldentails (both color varieties) are identical.
2. It seems highly probable that *R. milesi* is a synonym for *R. magdalenae, R. milesi* merely representing a variation with a gold tail margin and perhaps greater body depth.
3. Due to factors such as fin and scale counts, and tail shape, it does not appear that *R. elegans* and *R. milesi* (= *R. magdalenae*?) are conspecific. However, it is likely that *godmani* and *leucurus* are subspecies of *R. elegans*, with distinct geographical ranges.
4. For the time being, aquarists can do no better than to use the name, *Rivulus milesi*, for all forms of the goldentail rivulus. I could not, in honesty, however, disagree with anyone who wanted to use that name, *magdalenae*, although I would take exception to the use of the term *elegans*.

TABLE I: Counts and measurements of the Elegans Complex

Species	Dorsal	Anal	Lateral scales	Depth	Number of specimens	Distribution
brunneus	8-10	12-14	33-40	161-182	8	Canal Zone, Panama
chucunaque	7-9	14	36-40	143-154	79	Rio Chucunaque, Panama
montium	8-9	12-13	33-38	143-167	7	Chagres Basin, Panama
tenuis	8	11	38	182	1	Oaxaca, Mexico
godmani	8	11-13	35-38	149-189	5	Montagua River, Guatemala
elegans	7-8	13-15	35-36	158-188	7	Cauca & San Juan Basins, Columbia
milesi	10	13-15	37-39	188-191	6	Magdalena and Meta Basins, Columbia
leucurus	7-9	13-14	31-33	190-193	15	Atrato System, Columbia
magdalenae	9-11	15-16	40-42	161-167	26	Magdalena Basin, Columbia
goldentail	9-11	13-15	35-44	182-193	17	Magdalena and Meta Basins, Columbia

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THE KILLIFISH EGG
by Albert J. Klee

JAKA Vol. 2, Issue 1, pp. 9-15, 1965

The development of a fish egg, although a wonderful process, is admittedly a complicated one. It would be rash indeed to promise that one short article would make what is truly involved, a simple matter. But few killifish fanciers are really interested in the detailed embryology of fish eggs, however. What is desired are the answers to some very specific and practical questions, among them including: (a) what are the mechanisms that protect killifish eggs against adverse conditions? (b) What are the stages in the development of such eggs? (c) To what degree, and how, may the aquarist influence these stages? We really do not have all of the answers to these questions but the following discussion summarizes what is known or believed to be true at the present time.

CLASSIFICATION OF BREEDING TYPES

In general, killifish fanciers divide the majority of their fishes into three basic groups, viz., "plant breeders," "soil breeders" and "switch breeders." These categories are not to be

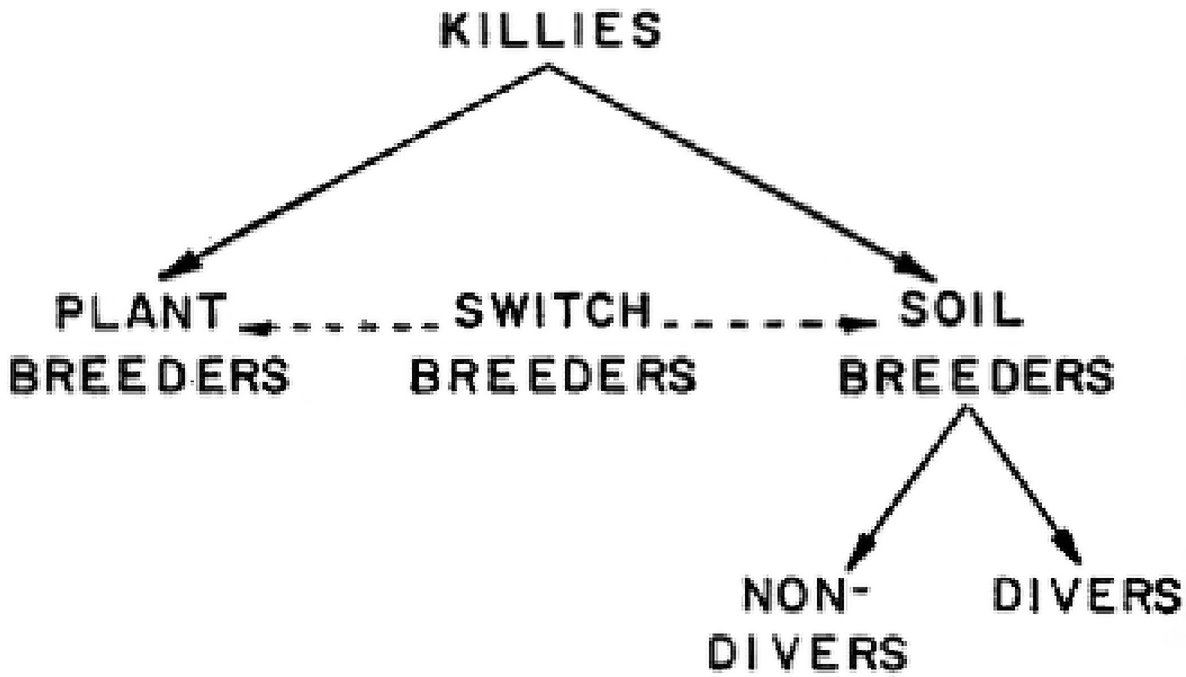


FIGURE 1: CLASSIFICATION OF KILLIFISH BREEDING BEHAVIOR

taken literally by any means. For example, very few aquarists nowadays use plants to spawn fishes of the first category (nylon mops are preferred). By these three terms we simply mean the following: given a choice of spawning possibilities, should the fish consistently select the floating mops (or plants), then it is termed a plant breeder; if it consistently selects some bottom substrate (bottom mop, peat, sand, etc.), then it is termed a soil breeder; and should the selections essentially be questionable as far as consistency is concerned, then the third category, switch breeder (a term I devised some five years ago), is used. Since the word "consistent" is somewhat vague, one can see that our terminology is not hard-and-fast by any means. It should be noted; however, that very many of our killifishes rightly are switching breeders ... many more than are currently recognized. Examples would be as follows: plant breeder - *Rivulus hartii*, soil breeder - *Nothobranchius guentheri*, and switch breeder - *Aphyosemion nigerianum*. Bear in mind that it also would be an error if the aquarist believed that, faced with the absence of its preferred spawning substrate, a fish would not spawn in a different manner. In the absence of mops, for example, the Lyretail (*Aphyosemion australe*) will even spawn on the gravel. As we shall see shortly, there are great structural differences between the eggs of a plant breeder and those of a soil breeder, however.

The division of these three basic categories may be carried one step further since soil breeders can be divided into "diving" and "non-diving" categories. The former fishes (e.g., *Cynolebias whitei*) dive deep into the bottom substrate while depositing their eggs, while the latter lay their eggs near the surface of the substrate (e.g., *Nothobranchius guentheri*). Because of possible damage to fins and/or gills, killifish fanciers prefer to avoid the use of sand as a substrate for divers. There is one additional term used by hobbyists in regard to killies, i.e., "annual fish."

Originally, this term was applied to those fishes which live in nature in an environment alternately (seasonally) dry and wet. Such fishes breed in nature during the wet season and die at the onset of the dry season. Their eggs, however, remain safely deposited in the mud until the arrival of the rains, whereupon they hatch. There are numerous soil breeders, however, which are not annuals in a strict sense. Unquestionably, for example, *Nothobranchius* species are annuals, but what about *Aphyosemion gardneri*? The latter is certainly a soil breeder (actually a switch breeder) but in nature, it does not always seem to be affected by its environment in the same manner as is *Nothobranchius*. *Nothobranchius* species are assured a dry season but *Aphyosemion gardneri* is not. Thus, the terms plant breeder, soil breeder, switch breeder and diver refer to the breeding behavior of killies. The term "annual," however, defines a special relationship of fish and egg to its environment. Figure 1 characterizes killifishes by their breeding behavior.

STRUCTURE OF THE EGG

Structurally, there are important differences among the eggs of killifishes. The shell of a plant breeder egg differs considerably from that of a soil breeder. The former is relatively thin, rigid and non-laminated. Furthermore, it has relatively little resistance to the transport of water molecules or oxygen across its surface. It is provided at each pole with a number of long, sticky threads that twist into a "bundle," enabling the egg to stick to its spawning site. On the other hand, the shell of the egg of a soil breeder is relatively thick and composed of many layers laminated together in the manner of plywood. It is relatively resistant to moisture transport, and in many cases, to oxygen transport as well.

Why these differences between the two types? The eggs of the plant breeders are immersed totally in fluid, i.e., water, and consequently the pressure exerted upon them is distributed equally all over its surface (Pascal's Law of Fluids - "Pressure exerted in a fluid is exerted equally in all directions"). The soil breeder egg, on the other hand, must undergo pressures in solids or semi-solids (i.e., peat, sand, mud, etc.) and consequently must endure greater pressures. Some soil breeder eggs such as those of *Nothobranchius guentheri* have a "geodesic dome-like" surface of hexagonal plates. Such plates provide additional resistance to external pressures. The eggs of *N. guentheri*, for example, have been known to withstand carefully applied weights of up to 7/10ths of a pound, and those of *Pterolebias longipinnis* up to 11/10ths of a pound!

Soil breeder eggs do not have the very long, sticky threads that characterize the eggs of the plant breeders. Some soil breeder eggs, e.g., those of *Nothobranchius* species, *Aphyosemion gardneri* and *Cynolebias ladigesi*, are strictly non-adhesive in that not only do they lack these sticky threads but the egg surface itself is non-sticky. Peat, therefore, does not stick to such eggs. But some soil breeder eggs have decidedly sticky surfaces, e.g., *Aphyosemion coeruleum* and *Aphyosemion labarrei*. The eggs of South American annuals are covered with many short, adhesive hairs but in the diver category, these hairs are so short as to form "buds" rather than hairs. However, the eggs of *Cynolebias melanotaenia* are covered with numerous medium-length, stiff hairs that resemble miniature palm trees. The purpose of sticky surfaces and/or hairs in soil breeders is to pull substrate particles (i.e., peat, mud, etc.) close to the egg surface, thus reducing moisture losses. The purpose in plant breeders, however, is more to camouflage the egg so that it will escape detection by predators.

STAGES IN EGG DEVELOPMENT

It remains now to investigate the various stages in the development of a killifish egg. There are two general phase types to consider, viz., a development stage (DS) and a resting stage (RS). A resting stage is a phase in the development of an egg when metabolism is reduced to a minimum and conversely, a development stage is one of increased metabolism. By consulting Figure 2, we may follow the development of a typical killifish egg be it plant breeder or soil breeder.

1. After an egg is laid and fertilized, development stage I (DS-I) begins immediately. This consists of normal cell division up to the point where the cells produce a yolk sphere and an embryonic disk. Unless the aquarist has access to a microscope, these subtle changes cannot be noted by the unaided eye. DS-I is usually completed in from 2 to 3 days.

2. Plant breeder eggs normally skip the next stage, which is termed resting stage I, and go directly to development stage II. However, the soil breeder eggs which are deposited in the bottom substrate in nature, now find themselves in an oxygen-deficient environment due to the oxygen consumption of the organic detritus on the bottom. RS-I ends only when the environment is again rich in oxygen. This occurs in nature when the pond dries (and in the aquarium when the aquarist himself dries the substrate). When dried, the substrate (i.e., peat usually) is exposed to the air trapped within or around it, thus providing exposure to the needed oxygen. Since RS-I is generally dependent upon environment, it is under the partial control of the aquarist. The aquarist may elect to take a path entirely different from nature and keep the eggs in well-oxygenated water, until the completion of DS-II. This will automatically eliminate RS-I or reduce its duration. It also works in reverse, however, for if eggs are kept in dirty water (i.e., oxygen-consuming water), then they too will enter RS-I and their development delayed (although in dirty water, the thin-shelled plant breeder eggs are likely to rot).

We have said that RS-I is generally dependent upon environment but certain eggs of many annual species are not influenced by environment at all during this stage. The most notorious among killies in this regard is *Pterolebias peruensis* since all of its eggs go into RS-I for a minimum of roughly three months, before entering DS-II. The situation in other annuals is not anywhere near as drastic in general (some species of *Austrofundulus* and *Pterolebias zonatus*, form an exception in that they are like *Pterolebias peruensis*) but there will always be some eggs for each species that will enter RS-I and stay there regardless of what the aquarist does. Eggs in resting stages have been termed “resting eggs” but strictly speaking, the term should apply only to those eggs whose resting stages are beyond the control of the aquarist.

3. In development stage II, the embryo develops further and specialization begins. Now the head (with eyes), brain, trunk and rudimentary tail are formed (and visible to the naked eye). When the length of the embryo reaches one-half of the circumference of the yolk sphere (so that it bends 180 degrees around it), RS-II is entered into by African soil breeders but it is not, however, entered into by plant breeders or South American soil breeders. Both of these groups go directly to DS-III. For African soil breeders, RS-II is entered approximately 2 to 3 days after the end of RS-I.

4. Unfortunately, aquarists have not discovered any consistent way to influence RS-II. Moreover, it appears to be a variable peculiar to each individual fish within a species, and can usually vary from about 5 to 50 days (but much longer durations are known for some species). RS-II is a problem mainly with species of *Nothobranchius* and this “interrupted development” is quite characteristic of the genus.

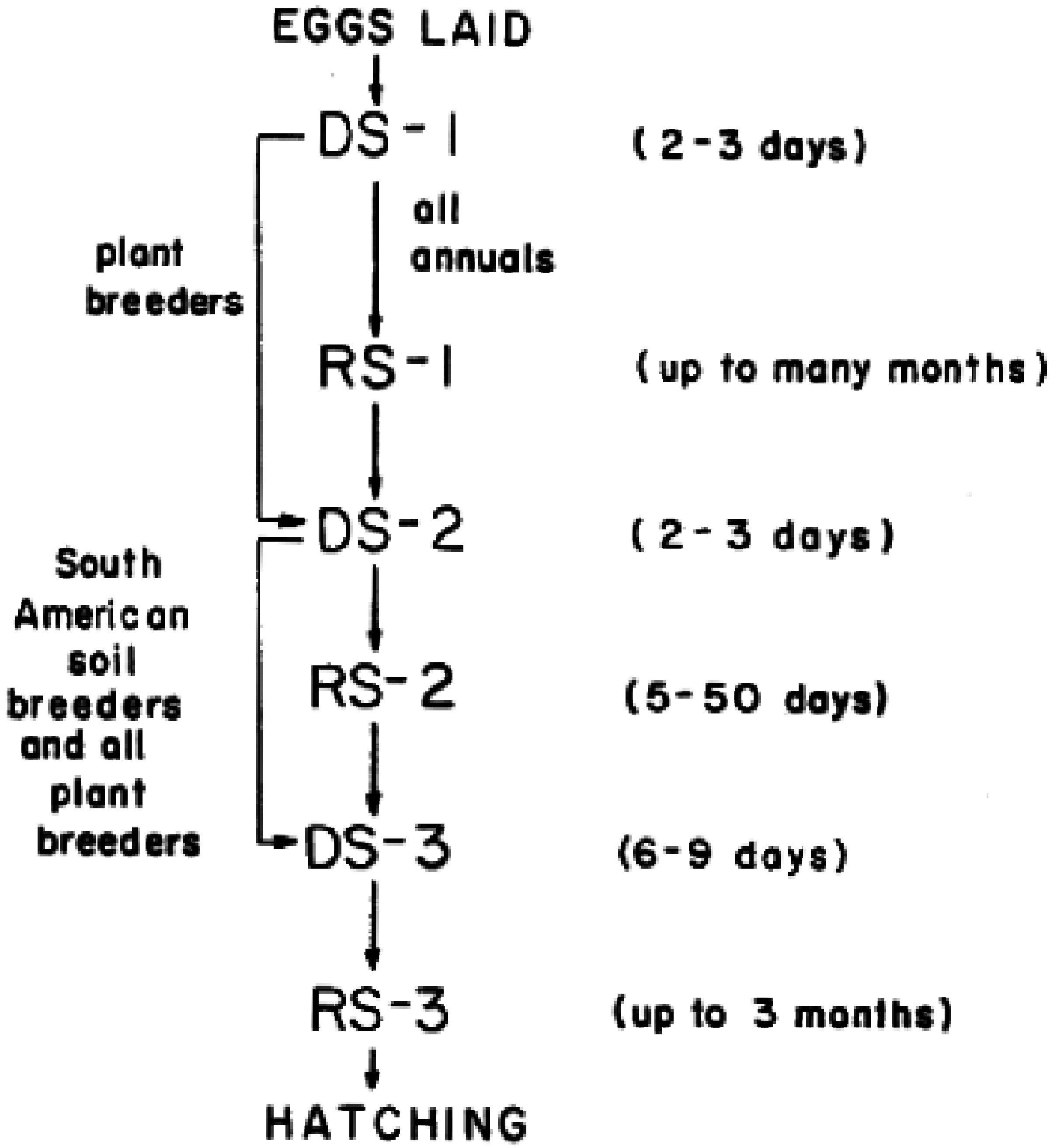


FIGURE 2: STAGES IN THE DEVELOPMENT OF A KILLIFISH EGG.
DS = DEVELOPMENT STAGE
RS = RESTING STAGE

5. DS-III is a period (about 6 to 9 days) during which the embryo gains considerably in size. Also, the pectoral and tail fins are added as well as fin edges. Further specialization takes place and when the embryo length exceeds by 25% (or more, depending upon the species), it is ready for hatching. Its growth is now ended and blood circulation is started

(although it may stop temporarily at times). The embryo, being so large, is under a partial compression within the egg.

6. All killifish enter RS-III unless it is terminated immediately by the aquarist or by nature. RS-III permits the embryo to remain for months (usually up to 3 months for soil breeders, although eggs of *Cynolebias nigripinnis*, for example, have been successfully hatched after 2 years!), living off its yolk reserve but ready at all times to hatch. In order not to starve, the fry must hatch before all of its yolk is consumed. Failure to hatch before the yolk reserve is totally consumed is a major cause of deaths of plant breeder eggs. The "resting fry" (as they are termed) of the soil breeders and in particular, those of the annuals, are much better adapted to survive in the egg than are the resting fry of the plant breeders. The blood circulation of the former is intermittent, thus oxygen (and yolk) consumption is smaller. The circulation of the plant breeder embryo is constant.

It should be noted from Figure 2 that the eggs of soil breeders take no longer for their active development than do those of the plant breeders (about 10-15 days). It is the resting stages that make the difference. Finally, it should also be recognized that the eggs of the plant breeders may be handled as if they were soil breeders, i.e., they may be stored in peat. However, this invariably increases total time -to- hatching, and further results in increased egg mortality as plant breeder eggs; as we have pointed out, do not have the physical or osmotic resistance of their soil breeder counterparts.

HATCHING

The preceding summarizes the phases in the development of a killifish egg as it is presently known; it now remains to discuss the "liberation" mechanisms whereby the embryo is able to hatch from its egg. The procedure is, for the soil breeders, as follows:

(a) In nature, the rains arrive with oxygen-rich waters, freely mixed with the organic-rich (plant and animal parts) bottom substrate.

(b) This then initiates decomposition of the organic material, subsequently lowering the oxygen content of the new environment and increasing its carbon dioxide content as well.

(c) These new environmental conditions cause the embryo to develop certain enzymes which dissolve the innermost layers of the egg hull, permitting osmotic action to swell the egg shell to beyond its previous size.

(d) This stress on the egg shell in combination with the compressive force stored up in the bent embryo, are now sufficient to split the egg, open it and release the fry.

In the case of plant breeders, the reduced oxygen tension and increased carbon dioxide tension that occurs in the evening in any plant environment, triggers the identical response and the fry are freed. It should be noted that in nature, the drying of the ponds is irregular, i.e., the outermost edges dry before the middle of the pond; those areas exposed to the direct rays of the sun will dry before those shaded, etc. Furthermore, some eggs will be buried more deeply than others and, of course, some are true resting eggs described previously. Consequently, eggs in nature may be in a variety of phases of development at any one time. Thus, nature insures that an early rain followed by a short, temporary dry season, will not spell death to the species.

We have noted that the fry is usually released from the egg via reduced oxygen tension or by increased carbon dioxide tension. This may be accomplished by the aquarist in a number of ways ranging from the absurdly simple expedient of blowing into a dish of water containing the eggs (the breath supplies the carbon dioxide!), to adding powdered food, microworm cultures, fancy brews, etc., to produce a state of lowered oxygen tension and high carbon dioxide tension. Mechanical means such as vibration also may be used to rupture the egg membrane.

Not to be overlooked, of course, is that conditions might already be favorable for the hatching of eggs and consequently, no "force hatching" is needed. Fortunately, this is most often the case since soil breeder eggs are usually stored in peat, a material which already is organic in nature; and plant breeder eggs are usually stored in very small quantities of water which, after a while, normally suffer from reduced oxygen tension automatically. It is interesting to note that since aquarists are able to influence the total development time (which includes resting) to some extent that as this varies, so also will the quantity of yolk that the fish is born with. This has obvious significance in the time and nature of the first feeding of the fry by the aquarist.

Yes, the ways of nature truly are fascinating and the natural history of the killifish egg is one of her most wonderful stories!

A QUICK REVIEW OF NOTHOBRANCHIUS

by Albert J. Klee

JAKA Vol. 2, Issue 2, pp. 11-16, 1965

INTRODUCTION

On a number of occasions, queries have been received regarding the taxonomic status of fishes in the genus *Nothobranchius*. Unfortunately, the status of a majority of these species is uncertain at best, making it very difficult to answer these questions. In the course of researches into this genus, however, bits and ends of information have been accumulated, some of which may be of interest to serious students of killifishes. An example is the following list of all species of *Nothobranchius* described to date. In each case, the original reference to the species is given, followed by fin and scale counts plus habitat information. No attempt has been made to provide descriptions of these species as in most cases, the descriptions of the preserved specimens are almost worthless for aquarium purposes. Following the list are a few brief remarks on the possible or probable relationships among these species. Aquarists desiring to pursue the subject further may obtain microfilms of the references listed from repository libraries such as the one at Stanford University.

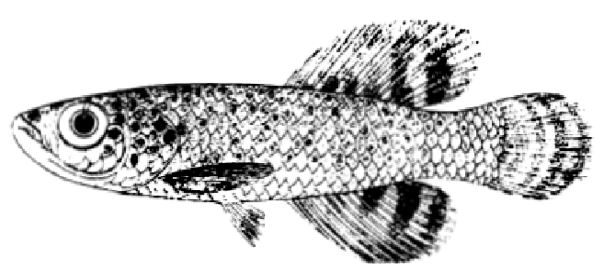
ALPHABETICAL LIST OF SPECIES

Nothobranchius brieni Poll
Reference: Poll, M., "Poissons du Katanga recoltes par le professeur Paul Brien", Rev. Zool. Bot. Afr., XXX, pg. 409, 1938 Counts: D 14-18; A 15-19; Ll. 27-30; Tr. 22-26 Localities: Bukana (Lualaba river) lower Lufira river, Kisungu marshes near Jadotville, all in the Congo Republic.

Nothobranchius emini Ahl Reference: Ahl, E., "Uber neue oder seltene afrikanische Zahnkarpfen der Gattungen Aphyosemion und Nothobranchius," Zool. Anz., 112, Heft 5/6 pgs. 125-126, 1935 Counts: D 15; A 14; Ll. 26; Tr. 26 Localities: Kongoran Botto, Tanganyika.

Nothobranchius gambiensis (Svennson) Reference: Svensson, G. S., "Freshwater fishes from the Gambia River," Kungl. Svenska Veten. Handlingar, Tredje series, Band 12, No. 3, 1933 Counts: D 15; A 15; Ll. 30; Tr. 24 Localities: Vicinity of MacCarthy Island in the Gambia river, about 200 miles from Bathurst, Gambia.

Nothobranchius guentheri (Pfeffer) Reference: Pfeffer, G., "Ostafrikanische Fische



Fundulus mkuziensis

gesammelt von Herrn Dr. F. Stuhlmann in jahre 1888 und 1889", Jahrb. Hamburg. Anst. X, pg. 167, 1893 Counts: D 17-18; A 18-19; Ll. 27-30; Tr. 24-28 Localities: Mombasa to Pangani river, Tanganyika; Zanzibar.

Nothobranchius kiyawensis Ahl Reference: Ahl. E., "Descriptions of two new cyprinodont fishes from Nigeria," Ann. Mus. Nat. Hist., Vol. II, Series 10, pgs. 601- 602, 1928 Counts: D 13-15; A 14-15; Ll. 26; Tr. 24 Localities: Kiyawa river near Katagum, Northern Province, Nigeria.

Nothobranchius kuhntae (Ahl) Reference: Ahl, E., "Neue oder selten importierte Fische," Bl. Aquarienkunde-Terrarienkunde, Stuttgart, 37, pg. 222, 1926 Counts: D 14-16; A 13-15; Ll. 30 Localities: Beira, Mozambique.

Nothobranchius mayeri Ahl Reference: Ahl, E., loc. cit., Zool. Anz. 1935, pgs. 126-127 Counts: D 16; A 17; Ll. 32; Tr. 40 Localities: Beira, Mozambique.

Nothobranchius melanospilus (Pfeffer) Reference: Pfeffer, G ., "Die Thierwelt Ost-Africas und der Nachbargebiete," Lief. V , Die Fische Ost-Africas, pg. 48, 1896 Counts: D 14; A 16; Ll. 30-31; Tr. 22-24 Localities: Longo Bay, Zanzibar.

Nothobranchius microlepis (Vinciguerra) Reference: Vinciguerra, D, "Pesci della regione dei Somali," Annali del Museo Civico di Storia Naturali di Genova, Ser. 2, Vol. XVII, pgs. 356-358, 1896-97 Counts: D 16-17; A 17-18; Ll. 40-42; Tr. 26-28 Localities: Near Mount Egherta between Brava and Lugh, Somalia.

Nothobranchius mkuziensis (Fowler) Reference: Fowler, H. W., "Natal Fishes obtained by Mr. H. W. Bell- Marley", Ann. Natal Mus., 7, pg. 411, 1934 Counts: D 16; A 15; Ll. 27-29; Tr. 9 Localities: Mkuzi river, Natal.

Nothobranchius neumanni (Hilgendorf) Reference: Hilgendorf, F., "Fische von Deutsche von Deutsch und Englisch Ost Africa", Zool. Jahrb., Syst. XXII, pg. 417, 1905 Counts: D 15-16; A 16-17; Ll. 30-32; Tr. 32-36 Localities: North Ugogo, Tanganyika.

Nothobranchius orthonotus (Peters) Reference: Peters, W. C. H., Monatsber, Akad. Wiss. Berlin, pg. 35, 1844 Counts: D 15-16; A 14-16; Ll. 28-30; Tr. 24 Localities: Quellimane, Mozambique.

Nothobranchius palmquisti (Loennberg) Reference: Loenberg, E., "Fishes", Sjoestedt's Kilimandjaro-Meru Expedition, 5, Pg. 7, 1907 Counts: D 16; A 15; Ll. 27-28; Tr. 22 Localities: Tanga, Usambara, Tanganyika.

Nothobranchius patrizii (Vinciguerra) Reference: Vinciguerra, D., "Enumerazione di alcune specie di Pesci della Somalia ltaliana," Ann. del Mus. Civ. di St. Nat., Vol. LII, pgs. 254-257, 1927 Counts: D 16; A 15; Ll. 25-26; Tr. 12 Localities: Between Fakia and Ilescid on the road to Geledi, Somalia.

Nothobranchius rachovii Ahl Reference: Ahl, E., loc. cit. Bl. Aqu.-Terrkd., 37, 1926, pg. 346 Counts: D 15; A 15-16; Ll. 25-26; Tr. 22 Localities: Beira, Mozambique.

Nothobranchius robustus Ahl Reference: Ahl, E., loc. cit. Zool. Anz., 112, 1935, pgs. 128-129 Counts: D 17; A 15; Ll. 33; Tr. 24 Localities: Swampy bay of Tschangarra, North Usinja, Tanganyika.

Nothobranchius rubroreticulatus Blache and Miton Reference: Blache, J. and F. Miton, "Poissons nouveaux du bassin du Tchad et du bassin adjacent du Mayo Kebbi", Bul. du Museum Nat. d'Histoire Naturelle, 2 serie, Tome 32, No. 3, pgs. 2 1 5 - 2 1 6 , 1960 Counts: D 16-20; A 16-20; Ll. 29-34; Tr. 24-30 Localities: Koundoul and Bahr Marako, both near Fort Lamy, Tchad.

Nothobranchius seychellensis Ahl Reference: Ahl. E., loc. cit., Zool. Anz., 112, 1935, pg. 128 Counts: D 14-15; A 17-18; Ll. 30-31; Tr. 22-24 Localities: Seychelles.

Nothobranchius taeniopygus (Hilgendorf) Reference: Hilgendorf, F., "Fische aus dem Victoria-Nyanza, gesammelt von dem verstorbenen Dr. G. A. Fischer," Sitzb. ges.

nat. fr. berl., pgs. 75-78, 1888 Counts: D 16-17; A 16-18; Ll. 30-31; Tr. 22-24 Localities: Lake Tshaya in Unyamwesi, Bubu river, south of Lake Manyara; Lake Victoria.

Nothobranchius troemneri (Myers) Reference: Myers, G. S., "A new cyprinodont fish from East Africa", The Fish Culturist, 6, No. 2, pg. 91, 1926 Counts: D 15; A 15; Ll. 33; Tr. 27 Localities: Unknown (based upon an aquarium specimen).

Nothobranchius vosseleri Ahl Reference: Ahl, E., "Neue afrikanische Zahnkarpfen aus dem Zoologischen Museum Berlin," Zool. Anz., 61, pgs. 144-145, 1924 Counts: D 15; A 14; Ll. 28; Tr. 22 Localities: Mombo, Tanganyika.

NOTES: The following fishes have been considered as belonging to Nothobranchius but they are, in reality, misplaced specimens.

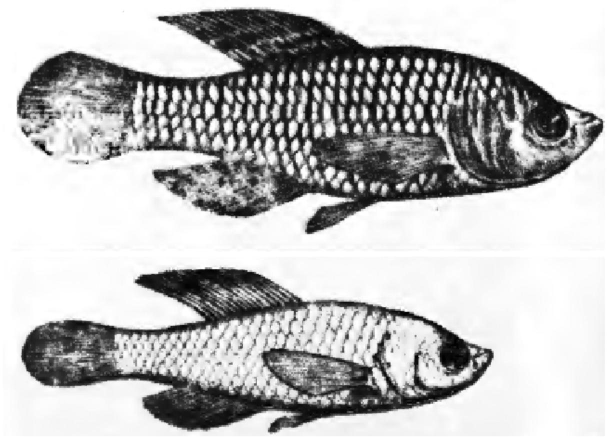
1. "*Fundulus capensis*" Garman 1895 = Mollienesia sphenops
2. "*Fundulus nisorius*" Cope 1871 = Fundulus heteroclitus
3. "*Nothobranchius amsingki*" Ahl 1928 (Reference: Ahl, E., Fischbestimmungsstelle", *Das Aquarium Berlin*, Vol. II, pg. 193, 1928), reportedly from Cotonou on the coast of Dahomey, was not properly described in the reference given. Dr. Ahl mentions in the reference that a proper description was in preparation for the Zoologischer Anzeiger, however, this was never done. In 1936, in Arnold and Ahl's "Fremdlaendische Suesswasserfische," these authors mention in passing in their description of *Aphyosemion bitaeniatum* that this fish and "*Aphyosemion amsingki*" were rarely seen in the hobby. Apparently, Dr. Ahl changed his mind and altered the generic placement of *amsingki*. The fish never was properly described, however, and to this day, we do not know the species Ahl referred to under this name.

DISCUSSION

The history of the genus starts with *Nothobranchius orthonotus* in 1844 (although it was placed into the genus *Cyprinodon* at that time). This is a coastal fish, found in Mozambique. One problem in identification of this species is that the type specimen is in very poor condition (after 121 years, this comes as no great surprise!), the jaws, for example, being very badly out of line. In 1866, Playfair and Guenther (in their "Fishes of Zanzibar") described some specimens of *Nothobranchius* collected by Col. Playfair under the then-only known name, "*Fundulus orthonotus*." They made a rather interesting observation: "It is remarkable that out of many hundred specimens observed by Col. Playfair at Zanzibar, Pangani (Tanganyika) and Seychelles, no female was ever found at the two first-named places, and no male at the last." Playfair and Guenther figured a male and a female, the latter with quite conspicuous black dots on its body.

In 1891, Pascha and Stuhlmann collected specimens of a fish subsequently referred by Hilgendorf to *Nothobranchius orthonotus*. The locality was Longo Bay, in reality a small stream running past the modern town of Frehami, Tanganyika (on the western edge of the coastal zone). In 1893, Pfeffer described "*Fundulus guentheri*" on the basis of four of these specimens, and in 1896 described "*Fundulus melanospilus*" on the basis of the other four and some additional material. Boulenger, in his 1915 Catalogue, decided that the fishes collected by Col. Playfair and described by Playfair and Guenther in 1866 as "*Fundulus orthonotus*," were separable into Pfeffer's and *melanospilus*. Accordingly, he placed Playfair's Zanzibar and Pangani males into *guentheri*, and his Seychelles females into *melanospilus*. Boulenger actually used Playfair and Guenther's illustrations to illustrate his Catalogue.

In 1935, Dr. Ahl took exception to Boulenger's placement of the Seychelles fe-



Nothobranchius patrizii, pair.

males into *melanospilus*. Ahl maintained that these females did not agree with Pfeffer's description of *melanospilus* and accordingly redescribed them as a new species, *Nothobranchius seychellensis*. At this point then, we summarize this history by pointing out that *orthonotus, taeniopygus* (described in 1888) and *guentheri* are definitely valid species. Whether *melanospilus* and *seychellensis* are separable from *orthonotus* is not certain, and in view of the poor condition of the *orthonotus* type, we probably will never know.

Backtracking a bit, three new species were added at the tum of the 19th Century: "*Fundulus microlepis*" in 1896-97 (from Somalia), "*Fundulus neumanni*" in 1905 (from the central portion of Tanganyika) and "*Fundulus palmquisti*" in 1907 (from the coastal area of Tanganyika). Although little is known of these species other than what we read, they seem valid enough at this time.

The period from 1924 through 1929 saw six additional species of Nothobranchius added to the genus: *vosseleri, kuhntae, rachovii, troemneri, patrizii* and *kiyawensis*. Two species may be dismissed very quickly as synonyms of *orthonotus*, viz., *kuhntae* and *troemneri*. Two are very definitely valid species, viz., *rachovii* and *kiyawensis* (the latter is the first of the genus described from West Africa). *Nothobranchius vosseleri* is one of those species not figured in its original description and furthermore, it was based upon but a single specimen. It is most likely a synonym for *Nothobranchius palmquisti*. The description of *patrizii* is suggestive of *palmquisti* in many respects, but presently, there is no reason not to accept it as a valid species.

The next burst of activity on the "Notho Front" occurred during the 1930's with the description of *gambiensis, mkuziensis, robustus, emini, mayeri* and *seychellensis*. We have, however, already discussed *seychellensis* and consider it to be a synonym of *melanospilus*. "*Fundulus gambiensis*" was described on the basis of a single specimen, a female. It appears identical with *kiyawensis*. "*Fundulus mkuziensis*" is a strangely-marked, dwarf species representing the southernmost range of the genus. It appears to be valid enough. *Nothobranchius robustus, emini* and *mayeri* each were described on the basis of but a single specimen. *Nothobranchius robustus*, a Great Lakes form, is certainly a synonym for *N. taeniopygus*. The type specimen of *N. emini* has a damaged caudal fin. In view of its counts, and habitat, I consider it as a synonym of *N. palmquisti*. As for *Nothobranchius mayeri*, we know that specimens of *orthonotus* from the Beira area are very variable in coloration, ranging from purple to almost green. Since *mayeri* is based upon but a single specimen, and in view of the geography involved and the variability of *orthonotus*, I consider *mayeri* to be a synonym.

Finally, the last two entries in the genus occurred in 1938 and 1960 with the additions of *brieni* and *rubroreticulatus*, respectively. However, *brieni* is at best, a synonym of *taeniopygus*. In short, in the light of our present knowledge, I consider the following to be "valid" species of the genus (listed along with their synonyms):

1. *guentheri*
2. *kiyawensis* (Synonym: *gambiensis*)
3. *melanospilus* (Synonym: *seychellensis*)
4. *microlepis*
5. *mkuziensis*
6. *neumanni*
7. *orthonotus* (Synonyms: *kuhntae, troemneri, mayeri*)
8. *palmquisti* (Synonyms: *vosseleri, emini*)
9. *patrizii*
10. *rachovii*
11. *rubroreticulatus*
12. *taeniopygus* (Synonyms: *brieni, robustus*)

The geography of the genus now simplifies to *kiyawensis* as the western form, *rubroreticulatus* as the north central form, *taeniopygus* as the more or less central form, *orthonotus, rachovii* and *mkuziensis* as southeastern forms, *guentheri, melanospilus, patrizii, microlepis* and *palmquisti* as northeastern forms, and *neumanni* as a non-coastal northeastern form. One should be very careful, however, in relating these "literature species" with aquarium species. There is an excellent chance that aquarium "*neumanni*" is not that fish at all, although the other familiar aquarium species seem properly identified at this time.

A NEW AQUARIUM RIVULID FROM SURINAME

Albert J. Klee, F.A.K.A.

JAKA Vol. 2, Issue 3, pp. 16-19, 1965

INTRODUCTION

Early in 1961, the author introduced to American aquarists a rather diminutive killifish known as *Rivulus agilae* (1,2). Unfortunately, the fish was never made available commercially, and it soon passed from the scene. Earlier this year, Mr. Don Mitchell of Buffalo, New York, was kind enough to send me 14 specimens of an unknown *Rivulus* species obtained from a local dealer. Prior to sending me the specimens, an attempt had been made to determine the name of the fish but, other than a passing suggestion that it might be *Rivulus dorni,* this was unsuccessful. Upon my receipt of the fish it was immediately recognized as *Rivulus agilae* Hoedeman, 1954, although there were some differences in tail pattern from those specimens which I had seen four years previously. Table 1 confirms that the Mitchell specimens are indeed *Rivulus agilae.*

Table 1 also shows that *Rivulus dorni,* a fish originating from Rio de Janiero, Brazil, was not a bad guess as, morphologically, this species closely resembles R. *agilae.* Furthermore, the distinctive tail pattern of the females is shared by both species. They are, however, quite distinguishable at a glance by virtue of very different markings. In an article by Axelrod (3), a Timmerman photograph bearing the legend, *"Rivulus dorni,"* is shown. This is a misidentification as the fish pictured is clearly a female R. *agilae.* Speaking of Mr. Timmerman, the noted Dutch photographer of fishes, we may remark that Dutch hobbyists were the first to import and keep this species in the aquarium.

DESCRIPTION

MALE: Body from lateral line through dorsum plus root of tail, rust-brown; body otherwise bright blue with rust-brown spots except that ventrum is light purplish; the rust-brown spots on the sides are in the form of roughly seven longitudinal rows, four of which are quite prominent. The anal fin is bright blue basally, middle yellow-green, edged in a thin black line and submargined in burnt-orange. The dorsal fin is mostly yellow-green with a mosaic pattern of orange dots; the anterior half of the fin rays are orange and the forward tip of the fin is yellow- green. The pectorals are clear at their base, yellow-green at the

Rivulus agilae,pair (male top).
Photograph by Albert J. Klee

edges. Ventrals are bluish basally, edged in burnt-orange. The upper three-quarters of the tail fin is brownish to brownish-orange, the lower one-quarter is green; the upper and trailing edge is bright orange, the lower edge black; there is some green between the fin rays in the upper three quarters of the fin. FEMALE: Body rust-brown, mottled dorsally, herringbone pattern on sides formed by greenish dots, gill covers dark brown. Anal and ventral fins orange. Pectorals clear at base with some traces of orange otherwise. Dorsal pale orange with mosaic pattern of brown to orange spots. Tail fin edged in orange, transparent otherwise; approximately five crescent-shaped rows of prominent dark spots concentric to outer edge of fin.

DISCUSSION

Rivulus agilae (pronounced AH'-GUH-LEE), which takes its name from the town of Agila in Suriname (Dutch Guiana) , is related primarily to *R. breviceps* and its relatives (e.g., *R. frenatus, A. geayi, R. dorni, R. brasiliensis,* etc.), all members of the BREVICEPS GROUP within the genus *Rivulus*. These are mostly very small species, *R. agilae* itself usually not exceeding 1-½ inches (4 cm) in length, although records of up to 2 inches (5 cm) are known for this species. These fishes are not very familiar to aquarists and, consequently, *R. agilae* represents a foot in the door, so to speak, with regard to a wholly different series of *Rivulus* species. In 1948, Hummelinck collected *R. agilae* at Zanderij, Suriname. This was a pool at the source of a swampy rivulet, permanent, and practically stagnant. The bottom consisted of quartz sand, mud and plant debris. *Utricularia* and algae grew abundantly. The water was clear, but slightly brownish, containing only 17 ppm chloride and 60 ppm hardness.

From an aquarium standpoint, *R. agilae* is a beautifully-colored fish, delightfully patterned albeit somewhat small. Its size, of course, is a disadvantage with regard to large, more aggressive species. Indeed, I have had several male *R. agilae* killed by young *R. hartii* not much larger than they, when refuge was not provided. *R. agilae* seems to be more of a bottom *Rivulus* than, for example, *R. hartii.* The latter is a robust form, dwelling in swift water and preferring the surface stratum. *R. agilae,* on the other hand, is less likely to jump than *R. hartii,* but a good rule is to cover all *Rivulus* tanks.

Breeding poses no special problems, but my experience is that eggs are not produced in very great quantities. I have not found males

TABLE 1

	R. *agilae*	Mitchell specimens	R. *dorni*
Dorsal rays	8-9	9	9
Anal rays	11-12	12	14
Lateral scales	31-37	34-35	28-31
Pectoral rays	12-14	13	13-14
Frontal squamation	f-type	f-type	f-type
Body pattern, male	longitudinal lines	longitudinal lines	vertical bars

Rivulus dorni

hard on females but the fact that I employ plenty of refuge (nylon mops) , and use a ratio of one male to two females may have some bearing on this. The eggs are clear, average 1.8 mm in diameter (quite large for so small a fish), and develop rather rapidly. Embryos are frequently fully formed within 7 to 10 days. The fry are fairly large and can take brine shrimp nauplii from the start. Perhaps not a large fish, but one of the prettiest members of the genus that aquarists will see, nevertheless.

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IDENTIFICATION OF TWO RIVULUS SPECIES

By Albert J. Klee, F.A.K.A.

JAKA Vol. 3, Issue 2, pp. 19-23, 1966

ABSTRACT

(1) Specimens of *Rivulus* resembling R. *hartii,* received by American aquarists during 1964, are herewith identified as *Rivulus holmiae* and *R. micropus.* (2) The Micropus Complex consists of five nominal species: *hartii, micropus, holmiae, bondi* and *waimacui.* (3) The Micropus Complex species originate from three basic areas: Amazon (*micropus),* Orinoco (*hartii* and *bondi),* and Guianas (*holmiae* and *waimacui).* (4) A reasonably conservative approach to the validity of these species would be to accept *micropus, hartii* and *holmiae,* and to consider *waimacui* a lowland form of *holmiae,* and *bondi* a western form of *hartii.* A "splitter" would accept all five species as valid; a "lumper" but one, *Rivulus micropus.*

Two years ago I was fortunate enough to come into possession of two rather pretty *Rivulus* species which resembled each other to a remarkable extent. Using the designations “U-1” and “U-2” for the present, a detailed description of these two forms follows (see Figures 1 and 2):

Rivulus U-1: Males-Orange-brown dorsally, ventrum pale orange; sides orange with seven or eight rows of small red spots on a violet background, spots small and tend to run together. Ventral fins green to orange, pectorals blood-red. Anal fin violet at base, middle portion greenish, broad edge of yellow-orange present; anal also decorated with rows of red spots. Dorsal fin shows pattern of deep-orange dots. Caudal fin bright-yellow to orange on upper and lower edges; base of fin greenish, mixed with orange, trailing edge quite blackish. Females-Orange-brown dorsally, and mottled; bluish-violet on sides, pale-orange ventrally; seven rows of reddish spots on sides; small ocellus on top of caudal

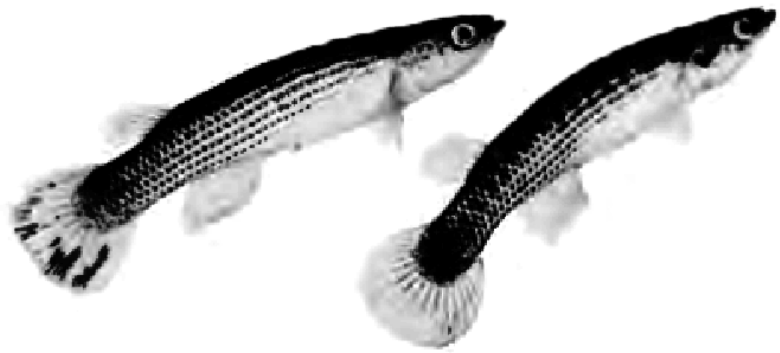
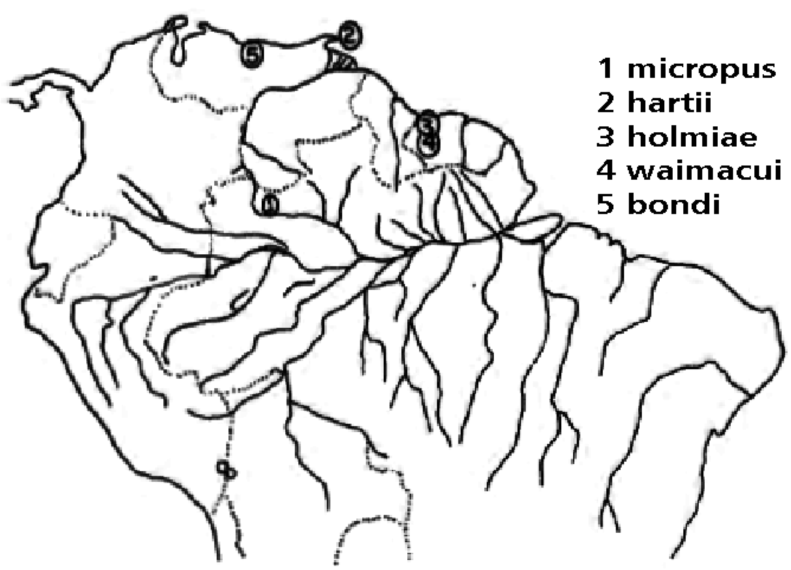


Figure 1: Rivulus holmiae or U-1. Male above, female below.

Photos by Klee

Figure 2: Rivulus micropus or U-2. Male above, Female below.



peduncle. Anal fin pink at base, middle greenish, edged in orange; anal also decorated with rows of reddish spots. Caudal dirty-red with blackish edging; ventrals green; pectorals pale orange; dorsal pale-orange.

Rivulus U-2: Males-Burnt-orange dorsally; sides strongly greenish, then blue, followed by violet ventrally; seven or more rows of red spots on sides. Ventrals bluish-green, pectorals yellowish. Anal violet at base, then blue; middle of fin green, edged in orange; anal also has rows of red spots. Dorsal violet at base, then orange; fin decorated with red spots. Caudal fin orange on upper edge, yellow on lower edge; greenish at base, remainder of fin weak, dirty-blackish. Females- Burnt-orange dorsally and mottled; sides greenish with rows of brownish spots; pink ventrally. Ocellus on top of caudal peduncle; several rows of green dots below lateral line. Ventral and pectoral fins colorless; caudal faint, dirty-violet; anal violet at base, otherwise green.

Basically, the differences between adults of the two species boiled down to the fact that the U -2 males were smaller, had more greenish sides, and displayed brighter and larger red body spots. The U-1 females had a more reddish tail and a less pronounced caudal ocellus. In young fish, the upper and lower edgings to the caudal fin were very orange in U -1, more greenish and narrower in U -2. When the fish were bred, another difference became known; the egg size in U -1 averaged 1.7 mm, while that in U -2 averaged 1.5 mm. Although the species admittedly are close, aquarists have had no difficulty in distinguishing the adult forms.

Soon after their introduction into this country in 1964, one ichthyologist pronounced them all to be *"Rivulus hartii."* Aquarists, however, wishing to distinguish between these two obviously different forms, christened one of them as *"Rivulus holmiae"* (in particular, U-1 was called "R. *hartii,"* while U-2 was referred to as "*R. holmiae").* Thus, these names received wide circulation throughout the AKA. In the course of preparing several AKA Index entries, however, it became necessary for me to do some microscope work in connection with both forms. The results are shown in Table I. Our U-2 appears to be *Rivulus micropus.*

TABLE 1

	U-1	U-2
Dorsal rays	8-9	7
Branched dorsal rays	7	5
Anal rays	16	13
Branched anal rays	13	10
Pectoral rays	16	13
Lateral scales	39-42	36-

The identification of U-1 and U-2 as *Rivulus holmiae* and R. *micropus,* respectively, makes considerable sense on geographical grounds. Commercial fish importers collect in *holmiae* and *micropus* territories, but they do not normally collect in *hartii* territory. It is pertinent to note that, at the same time U-1 and U-2 were introduced into the United States in 1964, *Rivulus urophthalmus* was also. *Rivulus urophthalmus* is found in both *holmiae* and *micropus* localities, but not in *hartii* areas. While on the subject of R. *urophthalmus,* we might spend a little time on how one distinguishes it from the Micropus Complex members. Although R. *urophthalmus* has a series of red lines on a green background as does *holmiae* and *micropus,* it does not have light-colored upper and lower tail edgings (see Figure 4). It is, moreover, a fish with much bright yellow and orange pigment on its fins and body.

After Regan's key, the next significant development came with the work of L. P. Schultz (2) in 1949. In attempting to explain reports of R. *hartii* and R. *micropus* from mainland Venezuela, he considered counting only the branched dorsal and anal fin rays. This resulted in the description of a new species, *Rivulus bondi,* from material collected in the western portion of Venezuela (Caracas; see Figure 3). Using Schultz's key, U-1 and U-2 key out to *Rivulus holmiae* and R. *hartii,* respectively. However, I attach no significance to this whatsoever, for Schultz had considerable difficulty with his branching method for identification. Using this method he was forced to conclude that:

(a) *Rivulus holmiae* is found on Margarita Island, Venezuela.

(b) *Rivulus bondi* and R. *hartii* are both found at Caripito, Venezuela.

Such conclusions violate some basic principles of species distribution. Schultz himself wrote: "**Among the material of *Rivulus* available from Venezuela I fail to find specimens that consistently agree with *hartii*... Further, in identifying specimens from Margarita Island as R. *holmiae,*"** he hedged: "**...I decided to identify the specimens, at least tentatively, with *holmiae* from British Guiana.**"

Hoedeman (3) found discrepancies in Schultz's method of counting the branched rays and had no difficulty in relegating the Margarita Island material to R. *hartii.* It was Hoedeman's thought that, with regard to the Micropus Complex fishes, **"larger samples will probably show them all to be one variable species.**" In a series of experiments conducted by the AKA's Publications Services Committee Chairman, Samuel Wineberg, it was found that U-1 and U-2 would hybridize successfully, thus lending some support to Hoedeman's contention. In Hoedeman's key to the genus (4), U-1 and U-2 key out to R. *holmiae* and R. *micropus,* respectively, as in Regan's key. I am satisfied that these identifications are "correct" in the light of our present knowledge of the Micropus Complex.

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ON THE IDENTITY OF THE "ACHILLES" *RIVULUS*

Albert J. Klee, FAKA

JAKA Vol. 4, Issue 2, pp. 21-24, 1967

ABSTRACT

The aquarium fish known as the "Achilles" *Rivulus* or *Rivulus "achilles"* is compared with other species in the genus, and found to be the true *Rivulus tenuis* Meek, 1904. *Rivulus "achilles"* is a colloquialism, not a scientific name: It is proposed that *R. tenuis* be hereafter colloquially referred to as Stoke's *Rivulus.*

In February 1966, my good friend E. J. ("Ted") Seymour, Technical Editor of the British Killiefish Association,* sent me a description and a color slide of a newly imported (into England) *Rivulus* known in the trade as *Rivulus "achilles,"* and requested assistance in its identification. It was reported that the fish was obtained from an exporter in Hong Kong. Sometime later, through the courtesy of the late Paul Stokes, then Chairman of the British Killiefish Association, I received two pairs of this fish.

A description of the fish follows:

Male: Sides bluish, ventrum green, many longitudinal rows of fine red spots. The rows do not show up well on this background, but produce the impression of a haphazard, quasi-herringbone pattern. Bright green spot on gill cover. Dorsal fin blackish with green spots, and top edge greenish-white. Pectorals greenish; ventrals green; anal fin bright blue at base, then green with thin black edge. Caudal fin divided into three sections by thin black lines that follow the contour of the upper and lower portions of the fin rays. Upper band often broken and indistinct. Upper and lower lobes (sections one and three) greenish-white, middle section blackish-red. Total length, about two inches (five centimeters).

Female: Flanks brownish-pink, dorsum dark, mottled with blotches and fine black dots. Base of dorsal fin whitish, remainder of fin clear to yellowish with many dark spots; pectorals colorless; ventrals and anal pale green. Caudal fin pale greenish yellow with some white on upper rays. Prominant black ocellus ("rivulus spot") in a white matrix on upper root of tail. A number of smaller black spots on tail itself, in vicinity of ocellus. Total length, about two inches.

The breeding of this fish was in the usual *Rivulus* fashion. Its eggs were clear, averaged 1.7 mm in diameter, and hatched within 14 to 16 days.

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*In order to prevent confusion among our members, let it be noted that the British Association spells killifish as "killiefish." The word "killifish" is of Dutch origin, a part of the inheritance we gained as a result of that nation's settlements in the New York-New Jersey area early in our history (See my article, *Why Not Panchax?,* in the February 1962 issue of *AKA Killie Notes,* p. 7). In 1961 I persuaded the Charter Committee of the AKA for good cause to adopt "killifish" over all other nominees and consequently, I am the one responsible for the use of this name throughout the hobby today. The name was proposed only after an extensive etymological investigation. Because of Col. J. J. Scheel's use of the word "killie," this term tacitly also was adopted by the AKA although I personally would much have preferred "killy" because of analogous terms of long standing in the aquarium hobby (e.g., molly, platy, guppy, etc.). Further, in point of history and etymology, "killy" is a far better term than "killie." However, in that any organization may spell its own name as it will, "Killiefish" in "British Killiefish Association" is certainly correct. In all other usage it is definitely incorrect and one can only express regret that this error has not yet been eliminated.

Specimens of the fish were sent to the British Museum of Natural History, and to Col. J. J. Scheel. The British Museum's examination was inconclusive and they remarked only that the fish "resembled" *Rivulus punctatus.* In this they were quite correct; but the predorsal length did not agree nor did the recorded descriptions of pattern. Consequently, the problem remained unsolved.

Col. Scheel, on the other hand, suggested that five species resembled *R. "achilles,"* viz., *R. urophthalmus,* R. *lanceolatus, R. santensis,* R. *xanthonotus,* and R. *limoncochae.* He concluded this after study of the fish's frontal scalation pattern (which is simply the arrangement of the scales on the top of the head), which he found to be of the *e-type.* The scheme of classification according to frontal scalation was devised by Hoedeman (1959), and later led to his well-known key (1961) to the species of the genus. Following Hoedeman, Scheel concluded that R. *"achilles"* best agreed with R. *urophthalmus.*

Using Regan's (1912) key, our mystery fish rather surprisingly keys out to be R. *tenuis,* a fish from southern Mexico. Meek (1904) described this species on the basis of a single specimen obtained from El Rule in Oaxaca Province. Meek's data are as follows: D 8, A 11, Ll. 38, predorsal scales 30. From Meek's illustration, I have measured the predorsal length (as % of standard length) as 77.5%. Morphologically, R. *tenuis* is indistinguishable from R. *"achilles"* as the following R. *"achilles"* data show: D 7-8, A 11-12, Ll. 38-39, predorsal length, 77.5%. Meek's illustration, which was that of a male, shows a caudal fin similar to that of *R. "achilles."* The lower portion (which, according to Meek, is "light") is separated from the major or middle portion by a distinct, thin, black line. The upper portion is delineated by a series of indistinct blotches, forming a broken dark line. Meek's sketch shows a rather deformed specimen, probably a fish stored a long while in formalin. Its head is deformed to a point, and the tail is depressed above and below. Meek stated that the caudal fin was "rounded." *R. "achilles,"* then, is identical with R. *tenuis* Meek, 1904.

R. *tenuis* (the name "tenuis" means "slim" or "slender") has had an interesting aquarium history. It was first imported into Germany in 1909 as R. *"flabellicauda."* The fish was obtained from the Coatzacoalcos region of Mexico and was transported on a ship that also made a stop at Puerto Limon in Costa Rica. In Germany it was thus erroneously thought by some that the fish came from Costa Rica. This led to misidentification as the nominally Costa Rican *R. flabellicauda. R. flabellicauda,* however, is a synonym for *R. isthmensis,* a fish quite distinct from R. *tenuis.* Most German references later changed *"flabellicauda"* (actually *isthmensis)* to the correct *tenuis,* but a few did not.
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In this I cannot concur, and this includes the other four species suggested as well. First, I do not accept the frontal scalation pattern as the best basis for classification. In a number of instances I have observed different patterns within the same species. Second, Hoedeman actually examined only a small portion (about 15%) of the total number of species of *Rivulus.* Third, the recorded descriptions of R. *urophthalmus* specifically state that the lower edge of the male's caudal fin is *n o t* pale, as it is in R. *"achilles."* I have kept specimens of R. *urophthalmus* which agreed in morphology, color and pattern with the literature descriptions. Consequently, I have no question about the rejection of that name for R. *"achilles."* The egg of R. *urophthalmus,* incidentally, is extremely small for that of a *Rivulus,* viz., 1.5 mm in diameter. This differs by an average of 0.2 mm from that of R. *"achilles."*

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Until 1951, the only ichthyological description of *R. tenuis* was that of Meek's single male specimen. In 1952, Alvarez and Carranza described a "new" species, *Rivulus "hendrichsi."* This fish was discovered by an expedition to the Rio Coatzacoalcos (Oaxaca) and its affluents in Mexico. The data on this species are as follows: D 7-8, A 11-13, Ll. 33-37 (mostly 33-35), predorsal scales 24-31 (mode 27), predorsal length 72.5-78.8% (average 76.6%). The description is essentially that of *Rivulus tenuis* and *R. hendrichsi* should therefore be considered a synonym.

Rivulus tenuis is a very old aquarium fish, but one which has not been seen in the hobby for over 30 years. The Spanish pronunciation of "El Killie" ("The Killie") is very close to "achilles." The real origin of this popular name, however, is not clear and it just as well might refer to the light-colored lower edge of the caudal fin, drawing an analogy to Achilles' weakness, i.e., on the heel. In order to honor his great service to the killifish hobby and the aquarium hobby in general, it is proposed that *Rivulus tenuis* be popularly known among killifish fanciers as "Stoke's *Rivulus."*

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LETTERS TO THE EDITOR

JAKA Vol. 4, Issue 2, pp. 21-24, 1967

I read Albert J. Klee's note, "On the identity of the 'achilles' *Rivulus"* in the *Journal of the American Killifish Association (4,* No. 2, pgs. 21-24, 1967) and found that, as often happens, he disagreed with my opinion on things.

I have reexamined the two males and two females preserved in formalin, kindly sent to me by E. J. Seymour. If Regan's key (1912) is used in the manner by Klee, then it is evident that the sole difference between *Rivulus urophthalmus* and R. *tenuis* is the black line (with white edge) in the lower portion of the caudal fin. The meristic characters agree, and Klee should have so informed readers.

The light-colored edge is not visible in my two males but there is a very faint dark line at some distance from the lower edge. But, in using the key as a first attempt at identification and in subsequently checking the origin of the preserved specimens upon which his description was based, Regan's paper lists: "1-2. 30-40 mm Coaxacoalos Arnold
3. 40 mm Bartsch." It is evident that the key was prepared on the basis of these individuals plus the single holotype of Meek.

The counts for the two species are as follows:

	"achilles"	*tenuis*
depth of body	4.0-4.25	4.5-5.0
length of eye	2.7-3.3	3.3-4.0
length of head	3.9-4.3	4.0-4.5
dorsal origin	2.0-2.8	2.6-3.0
dorsal/anal	first third of dorsal	middle of dorsal

Klee mentioned the predorsal length (not in the original description), giving this value as 77.5% for "achilles" (based upon Meek's picture). I found the following values: 74%, 74%, 76½% and 78½%. I wonder why Klee thought that he could use Meek's drawing of the type for *tenuis* so accurately when he did not notice the very different shape of the head between *tenuis* and "achilles." *If* this drawing *is* used to prove one thing, why cannot it be used to disprove others?

In any event, a study of the colors of *tenuis* soon discloses that this fish certainly cannot be the same fish we know as "achilles" from Hong Kong. The first published information concerning the colors in *tenuis* is that given by Gerlach in the old *Blaetter* in 1909 (Vol. 20, pgs. 797-799). He stated: "This spring I was informed by a friend in Hamburg that he had received in an importation from Mexico a pair of colorful *Rivulus* species which he was willing to hand over to me. Of this shipment, only a single pair arrived. Mr. Hartel, of Dresden, who was in Hamburg, brought the fish to me. The eggs did not differ in size nor in general appearance from those from the various species of *Rivulus* in my tanks, *Rivulus poeyi,* R. *elegans* and R. *ocellatus,* plus two other species, and they hatched within about the same time period as these other species. The juveniles were quick growing. All had a dark spot at the upper part of the caudal root, the spot being edged in white. At a length of 1 ½ to 2 cm, this spot disappeared in the males and, at the same time, the lower portions of their caudal fins developed a red color. At 5 cm the individuals were full grown. The natural home of these fishes is Mexico, the collector reporting that they had been caught near the new port of Puerto Mexico in the southern part of the eastern coast of Mexico. From a communication from Paul Matte of Lankwitz, I realized that he also had some individuals from this Mexican shipment.

"Males: *The area of the belly between the pectorals and the ventrals is red. The snout is red,* not unlike that seen in *Haplocheilus chaperi.* An indigo colored area is present on the gill covers. Red spots are present on the sides in an irregular fashion. Pectorals, ventrals and anal fins are yellowish-green (the last reddish on its distal portion). *The caudal has a handsome red color in the lower quarter;* the upper quarter is whitish green, the central portion is brownish and *separated from the green and red parts by a black horseshoe-shaped band.* The dorsal is white at its base with a broad light-green edge.

"Females: Anal fin white at the base with a brown marbled pattern and a submarginal broad yellowish-brown band plus black edge. Caudal with a marbled-brown pattern. The lower portion is almost uniformly brown and, *as in the male,* separated from the central part of the fin by a black band. *One* dark rivulus-spot at the upper part of the root of the caudal."

The next pertinent reference is that of Ehnle *(Blaetter,* Vol. 21, pgs. 341-343, 1910), entitled *"Rivulus flabellicauda": "The male has a brilliant red snout* as if dipped into red paint. Belly lemon, sides light-blue, back brown; the gill covers are dark greenish-blue; body with rows of reddish spots. The pectoral fins are light-yellow, ventrals greenish, the large anal fin yellow-green with a dark edge. The dorsal is yellow above, darker below. The caudal is yellowish-green above, carmine-red in the center, with a broad black band with a reddish-yellow area beneath. Female: Usually blackish-brown, sometimes light-yellow. *One* rivulus-spot at the upper root of the caudal. This fish comes from Puerto Mexico. Male 6 cm, female 7 cm."

The following were supplied as footnotes by the then-editor, Dr. Woltersdorff: "This article was received under the name *'Rivulus species',* referring to Gerlach's article of 1909. In the meanwhile, however, Boulenger has identified the fish as *Rivulus flabellicauda.* The fish is variable in coloration, exceptional males with an *intense red color on the belly between the pectorals and ventrals. Caudal with a wonderful red coloration in the lower quarter."*

The next reference is that of Friedrich (in *Blaetter,* Vol. 21, pgs. 637-638, 1910) under the name *"Rivulus flabellicauda":* "Males: Belly yellow to lemon, sides blue with irregularly distributed red spots. Back copper colored, gill covers blue. *Snout blood-red.* Dorsal and anal ochre, edged in blue. Pectorals reddish yellow. Caudal with three colors: upper part ochre, middle chrome-yellow with some red between the fin rays, separated from the lower part by a broad dark-blue band; lower part dark-red with some yellow. Female-one rivulus spot."

Rachow, in his paper in *Blaetter* (Vol. 23, pgs. 824-826, 1912) with the drawing by Thumm to which Klee refers, mentions Regan's paper and stated: "In this paper it is shown that the fish which we have called *Rivulus flabellicauda* is now *Rivulus tenuis."*

The three individuals which Regan used for his key, undoubtedly are specimens of the 1909 importation from Puerto Mexico (= Coatzacoalcas), these being sent to him by German aquarists (Arnold and Bartsch). After having read these three descriptions of colors and patterns based upon the originally imported specimens (1909-1910), I think that Klee's identification of "achilles" as *tenuis* is not justified. Conclusion: "achilles" is undoubtedly not identical with *tenuis* because of too great a difference among meristic characters and in color patterns. *Rivulus* "achilles" probably is not even *urophthalmus* although it agrees just as well with that species, which is known to have a large distribution (the whole lower part of the Amazon plus the Guianas), and in which a dark line may be present in the lower part of the caudal in some populations. *The identification of "achilles" remains unsolved.*

Re Hoedeman's frontal scalation patterns. I disagree with Klee that this character is highly variable, although in some species this is true *(Rivulus* milesi, the goldentail, is an example). This is natural because in the evolution of these patterns it is likely that presently, some populations of some species are in the process of changing the frontal scalation pattern. This is the case also in *Aphyosemion nigerianum, Procatopus gracilis,* etc. Generally, however, in all the cyprinodonts that I have inspected (several thousands), these patterns are remarkably constant and very useful in identification. In my four specimens of "achilles," the pattern is very constant. I do not know where Klee obtained his information that Hoedeman used only about 15% of the species of *Rivulus* for his key. I cooperated extensively with Hoedeman at the time and I know that he had examined very many individuals from many species, indeed.

As for "killiefish" versus "killifish," the word for "spring" or "fountain" is KILDE in Danish. Most likely I had the pronounced "e" in mind when I used the term "killiefish" or "killie letters." I do not think this to be a serious question.

J. J. *Scheel, Virum, Denmark*

LETTERS TO THE EDITOR

JAKA Vol. 4, Issue 2, pp. 21-24, 1967

In order to simplify things for readers, Col. Scheel makes five points in his letter as follows:

1) He states that, frequently, I am in disagreement with him.
2) On the basis of data he supplies, he maintains that "achilles" cannot be *tenuis* because there are great differences in certain meristics between the two.
3) On the basis of three aquarium accounts dating from 1909-1910, he states that the two fish cannot be the same because of significant differences in recorded color and pattern
4) He disagrees with me on the usefulness of Hoedeman's frontal scalation patterns in identifying certain killifishes.
5) He observes that most likely he had the Danish word "kilde" in mind, when he used the term "killiefish" or "Killie Letters," but he does not think that it is a serious question.
In order to be brief, my answers will he in outline form, numbered in accordance with the above points.

1) It is true we do not agree on all matters piscatorial. However, I consider Col. Scheel a distinguished adversary in those instances when we disagree, whose criticism is always valued. A good part of our divergence in nomenclatural matters is due to the fact that Col. Scheel is essentially a "splitter" (especially in generic terms) whereas I am a "lumper." For the benefit of those unfamiliar with these terms, "splitters" are those who prefer the narrowest standards of divergence and diversity with which to recognize taxa, and so tend to recognize maximum numbers of taxa at each level. "Lumpers," on the other hand, prefer the widest practicable standards and recognize minimum numbers of taxa. Dr. George Gaylord Simpson has given, tongue in cheek, the following definition of a splitter (rephrased somewhat): "A splitter is one who, if able to distinguish between two fishes, will place them in separate genera but if unable to distinguish between them, will place them in two separate species."

In view of this fundamental difference between us, we are bound to have a friendly disagreement at times. I am considerably discomforted, for example, at the present tendency to break down the genus *Aphyosemion* into countless other subdivisions. Where American ichthyologists are finding it more and more difficult to distinguish among *Cynolebias, Austrofundulus, Rachovia* and *Pterolebias,* European ichthyologists are attempting to further subdivide them. (In quite another field, I am distressed to find the genus *Symphysodon* divided into species and subspecies, mostly on the basis of single specimens with inadequate consideration of locality. This is nonsense and should be recognized for what it is. This silliness, however, is *not* due to European ichthyologists. The issue here, however, is *Rivulus tenuis;* perhaps we may exchange views on these other matters in a future issue of JAKA.

2) Col. Scheel hoists himself somewhat on his own petard when it comes to his comparison of meristic data between "achilles" and *tenuis.* If readers will examine Col. Scheel's data they will see that there is overlapping in three out of the five items presented, so much so that there is no statistically significant difference in these instances. Further, if we add additional data taken from the Alvarez and Carranza description of *Rivulus "hendrichsi"* (i.e., a synonym for *tenuis),* we find that the depth of body for *tenuis* is 3.8 to 5.0, not "4.5 to 5.0." Consequently, there is no significant difference here either. Finally if we consider the statement of Alvarez and Carranza that the "... origin of the dorsal is over the posterior part of the anal. . ." in

"hendrichsi," then there is no disagreement re the very last item.

As I clearly pointed out in my article: "Meek's sketch shows a rather deformed specimen, probably a fish stored a long while in formalin. Its head is deformed to a point, and the tail is depressed above and below." It must be clear that *shape* is altered by such deformation and consequently, means nothing. On the other hand, the relative position of the dorsal fin on the body is not changed to any great extent by such deformation (the tail does not even figure in such a computation). I indicated a value of 77.5% for Meek's holotype, but if Col. Scheel is unconvinced, we can simply use Alvarez and Carranza's data, viz., 72.5% to 78.8%.

SUMMARY: *"achilles" and* tenuis *agree extremely well in all counts and meristics examined by either Col. Scheel or myself.* 3) Col. Scheel places a great deal of emphasis on early descriptions of color and pattern in *tenuis* that appeared m the German aquarium literature circa 1909-1910. Readers are invited, however to note the virtual indistinguishableness of the Thumm drawing (drawn circa 1911) of the male *tenuis* with my photo of live "achilles" (page 24 of my JAKA article, loc. cit.). Further, if we add the "rivulus spots" mentioned by Rachow in the text that accompanied his article, then Thumm's drawing of the female *tenuis* and my photograph of a live female "achilles" are indistinguishable also. Skeptics may consult Arnold and Ahl, page 345, to see the drawing with the spots added, or, more simply, the AKA's own translation of the killifish portion of this work.

As for color, Col. Scheel makes a large issue of the presence of reddish-colored belly, red snout and red color in the lower portion of the tail fin in these early German descriptions. The accounts quoted, however, do not even agree. Gerlach states that the "... caudal has a handsome red color in the lower quarter ... "; Ehnle states that the caudal has "... carmine-red in the *center* ... "(My own description states: "... middle section blackish-red. . .") Further, Dr. Woltersdorff himself observed that: "... the fish is variable in coloration…," and that only "exceptional" males had the intense red color on the ventrum. Surely there is enough disagreement here to warrant some surprise that so much conclusion is based upon such a flimsy house of cards? I apologize for seeming to dismiss these aquarium accounts so brusquely, but anyone who has read early German accounts and descriptions of aquarium fishes is well aware of the great discrepancies between those accounts and the fish as we know them today. As it has been pointed out by Dr. Woltersdorff that *Rivulus tenuis* is so variable, can we not draw upon our experiences with another very variable *Rivulus,* i.e., *Rivulus milesi,* to conclude that mere differences in coloration do not necessarily different species make? The reflective aquarist will be able to evaluate Col. Scheel's "evidence" with very little difficulty.

4) With regard to Hoedeman's frontal scalation patterns, it is all very well to devise a thesis and then stick with it, but another to "explain" away all discrepancies by saying, "Oh, well, that case is different because the fish is evolving." I recall Hoedeman's lengthy discussion regarding *Rivulus milesi* whereupon he concluded that it "…must be considered a hybrid stock…" and opined that it represented a mixture (based upon analysis of frontal scalation pattern) of "60% *isthmensis.* 20% *cylindraceus,* the rest *urophthalmus* and *elegans.*" This borders on a burlesque!

Finally, I repeat again that there is no evidence in any of Hoedeman's work that he examined-even a simple majority of the species of *Rivulus* when he established his key. It is usual, when such a work is presented, to so state this information; no such statement was made.

Albert J. *Klee*
West Chester, Ohio

LETTERS TO THE EDITOR

JAKA Vol. 4, Issue 2, pp. 21-24, 1967

Identification of the "Achilles" *Rivulus* presents problems. If the genus were a small one I think one could identify (or describe and name) a *very distinctive* species, lacking locality data. However, that is not the situation here.

As I pointed out not long ago, the named forms of *Rivulus* have now become so numerous, and many of these are so similar, that identifying species or describing new ones, based on a few specimens, even *with* good locality data, has become a business of dubious taxonomic value. No doubt a number of the named forms will be found to vary greatly geographically and to merge in intermediate localities. For one thing, no museum has enough good material for comparison of specimens of more than a very few of the named forms, and all extant museum collections together probably do not have enough localities represented by good collections for a study of geographical variation of more than a very few species, *if any!* This is particularly true for Central America, the *Rivulus* species of which impress me as all rather closely related.

I could list a few named species from South America and the West Indies which do not appear closely related to any other described forms (e.g., *marmoratus, ocellatus, dorni, compactus, zygonectes, ornatus* and perhaps two or three others). But most or all the rest have what seem to be close relatives, and some synonymization of named species may be required. In my opinion, the least well-differentiated, named forms occur in the *urophthalmus* group (including *mazaruni, stagnatus,* and others), in the striped *punctatus-pearsoni* group, and among the Central American forms.

In each of the clusters (closely related assemblages) of species or subspecies, I suspect that the same ranges of scale counts, proportions, etc., will be found (which most identifications or descriptions *of Rivulus* now are) based on such things as scale-counts, a most uncertain thing. For example, Alvarez and Carranza, in describing the Mexican *R. hendrichsi,* found it necessary to compare it with the Amazonian *R. dibaphus,* which I feel has no close relationship with any of the Central American species. It merely is close in scale-count, but probably belongs with a quite different cluster of species or races.

Under such circumstances, and with no indication of whether the fish came from South America, the West Indies, or North America, I believe that the excellent analysis of the "Achilles" *Rivulus* Klee presented in *JAKA* 4 (2) is quite as good (perhaps much better) as I could do. I see no important point that has been missed. While I think that there is some taxonomic value in the scale pattern of the top of the head, I too have serious doubts that it is as important as Hoedeman believed. After examination of the two males and one female Klee sent me, I feel reasonably sure that the "Achilles" *Rivulus* is not a member of the *urophthalmus* group. In fact, after some checking, I agree that the fish seems to be closest to *Rivulus tenuis* (Meek), and I would be willing to accept that identification until and unless locality information is forthcoming showing that the "Achilles" *Rivulus* comes from a quite different area. The three specimens have been registered in the Stanford University fish research collection as number SU 66332.

George S. Myers, Ph.D.
Stanford University
Stanford, California

A HISTORY OF THE AMERICAN KILLIFISH ASSOCIATION

By Albert J. Klee

Killie Notes Vol. 4, Issue 1, pp. 22-28, 1971

It would, in my view, be wrong to dismiss this brief chronicle of the American Killifish Association simply on the grounds that one is not particularly interested in killifishes. The fact of the matter is that the AKA has been the most successful aquarium organization in the history of the hobby anywhere in the world, bar none. It is, therefore, relevant to any aquarist interested in hobby organizations, how they get started, what makes them tick and how they prosper. It is primarily for these reasons that this history is now put to paper.

The AKA was not the first serious attempt to formulate a killifish organization of at least national scope. Several years prior to the launching of the AKA, a proposal was made by Alan Fletcher, then Technical Editor of the old *Aquarium* magazine, that an "American Panchax Association" be formed. Although not a killy authority himself, he had observed the keen interest in these fishes and recognized the value of such an organization to the hobby. The suggestion, however, elicited little tangible response from aquarists. In a sense, this is commonly the experience of many club bulletin editors who plead in print for articles. The response is generally nil and some editors find that only direct face-to-face requests for specific material are fruitful. Fletcher, however, did approach two well-known killifish authorities but unfortunately, although these two hobbyists possessed the requisite technical killifish knowledge, they either did not have sufficient organizational ability, or lacked the spirit to cope with organizational details, admittedly not always an exciting assignment.

Thus we come to another dictum in hobby organization: It is not always the "expert" who is the most effective organizer. Yet, regardless of organizing ability, the man with the reputation or the "title" is almost automatically chosen to lead. In any event, thus died the "American Panchax Association," stillborn.

In August of 1961, the author's telephone rang: "Hello! I'm Bob Criger. I' m interested in killifishes and wonder if we couldn't get together tonight for dinner?" With this telephone call, in effect, the American Killifish Association was born. Bob, who was visiting his home offices of the Armco Steel Corporation in Middletown, Ohio (some 20 miles from where I lived), projected such bright enthusiasm over the phone that I accepted the invitation and drove to meet him.

Robert O. Criger turned out to be a tall, friendly, personable fellow, lately interested in killies. It turned out that his telephone call to me was triggered by a series of articles I had authored for the old *Aquarium Journal* (see Klee, Albert J., "A Fresh Look at the Genus *Aphyosemion*," *Aquarium Journal*, August, September, and October 1960). This particular series was one in which I had invested a great deal of time and effort for at the time, little information was available with regard to these fishes. Today, I look back at some of the inadequacies of that particular material with some misgiving. We have all learned much about killies since then!

In any event, Bob had read the series with interest, and, knowing that I lived in the area, took a chance, located my telephone number and called me out of the proverbial "clear blue sky." He was prepared with a list of killy topics for discussion that could have formed the basis for a good-sized book. These were tackled with enthusiasm for in those days, finding persons that were devoted to killies just wasn't easy!

The conversation continued after dinner. We bemoaned the scarcity, not only of information about killies, but of the scarcity of the fishes themselves (today's killifish fanciers are really spoiled by the relatively easy access of these fishes!). Sometime after midnight Bob thought out aloud: **"Wouldn't it be great if we had some sort of club devoted solely to killies?"** At first I was reluctant, knowing full well the work involved and that ventures of this sort usually wound up with but a few people carrying the main load, ultimately to fail because of general apathy. Further, the experience of the ill-fated "American Panchax Association" was not unknown to me. However, Bob was particularly interested in developing a professionally produced publication strictly for killies, and as he had had considerable publishing experience and access to processes and printers, his suggestion became persuasive. Then, too, the challenge of developing a really successful national aquarium organization was appealing and ultimately irresistible.

By our fifth highball, we mutually agreed to attempt the formation of a national killifish association. It was decided that Bob would handle publicity, membership and correspondence, and that he would simultaneously work out plans for a publication; to me fell the task of organization, planning, operations and By-Laws. On this note we parted, Bob returning to Kansas City, his home at that time.

One of the observations I had made regarding the failure of prior specialist's organizations (sundry national guppy and goldfish groups, and the International Federation of Aquarium Societies in particular), was that they seldom provided opportunities for practical but significant involvement on the part of the rank-and-file. Furthermore, I had observed that these so-called "national" efforts tended to become localized. Since not all hobbyists are affluent enough to attend meetings located far from their homes, the leadership of such organizations tended to concentrate in a limited number of geographic areas, with subsequent areal domination. With Bob in Kansas City and me in Cincinnati, we already had a fair start of sorts on geographical dispersion. A search was then initiated for aquarists living in other areas who were able to contribute to, and interested enough to participate in, a charter committee.

Our first invitation went to John Gonzales, then of Philadelphia. John is one of the real "old-timers" in the hobby. He was, for example, the first American aquarist to breed *Rasbora maculata*. A keener mind and superior breeder of killies could not be found. Due to a chronic back injury, John was forced to retire relatively early in life, but as he could not stand to be idle, he had decided to breed selected groups of fishes for the commercial market, i.e., those fishes requiring too much individual attention for commercial hatcheries to handle. Primary among the fishes he bred were killies.

In Chicago, we found two men with excellent qualifications. One was Charles Glut, an engineer who was gaining a reputation as an "innovator" in the killifish field. The other was George Maier, who possessed an enviable record of years of experience with aquarium fishes, particularly killies. At the time, George (who, with his wife, operated a fish store) was Advisory Editor of the now defunct *Tropicals Magazine*. George Maier, it might be mentioned, is a man for all occasions. His technical craftsmanship is flawless, and his warmth for people unsurpassed.

The next to be invited was Bruce Turner, of New York City. Bruce, then a student at Brooklyn University, lived, ate, and breathed killifishes (he later was to become a professional ichthyologist). He corresponded with collectors and professionals all over the world, and could rattle off the musty references to killifishes in the literature of a hundred years ago with the same facility the more typical teenager rattled off baseball averages. The last member of the Charter Committee was Bernard Halverson, a chemical engineer who had attained a national reputation when he persuaded the Houston Aquarium Society to sponsor the sale of dwarf white worms, then relatively unknown to the hobby. These men provided at least some of the geographical diversity we thought to be critical. It is somewhat ironic to note that we were not successful in obtaining West Coast representation on the Charter Committee. At the time, the killy fires were hottest in the East, and California fanciers were relatively unknown. How this has changed since then!

In order for a committee of seven people, dispersed about the country, to operate without chaos, some system of corresponding had to be devised. Thus, the Charter Committee served as an experimental vehicle in which to work out the modus operandi that basically was to be used by future Boards of Trustees of the AKA. John Gonzales was instrumental in suggesting the technique that finally proved workable. Briefly, the chairman of the group sends his letter to the others about the first of the month; by the middle of the month the others send their letters, with copies to all. The function of the chairman is to summarize comments, formalize motions, assign motions a number and a place on the agenda, and to conduct and record the vote. Thus, regardless of where a participant resides, he shares involvement in policy-making equally with the others in the group. The chairman has no greater powers than his peers. He is an equal among co-equals, but traditionally acts to minimize discord and to expedite the flow of business. This approach serves to eliminate the one-man-show responsible for the many prior failures of national organizations.
Many of the individual members of the Charter Committee, as might be expected, had particular interests in the structure of the Association. Charles Glut, for example, devoted much of his time to the concept of the "egg bank," a system whereby volunteer hobbyists would breed and maintain certain species of killifishes that might otherwise disappear from the hobby through neglect or lack of interest. (The internal debate over egg bank plans was, unfortunately, quite acrimonious.) Bruce Turner applied himself mainly to the organization's acquisition of new species; George Maier cultivated crucial support from aquarists in the important Chicago area; I occupied myself with the preparation of the By-Laws. All of us, however, actively discussed and debated all aspects of the new organization.

During this time, Bob Criger, acting as publicity liaison officer, contacted all of the national aquarium magazines with a view towards publishing news of the proposed organization and keeping aquarists informed of the progress of the Charter Committee. All agreed to cooperate with the single exception of the *Tropical Fish Hobbyist*. Although the *Aquarium Journal, Tropicals* and *Aquarium* magazines published many progress reports and announcements regarding the AKA, none ever appeared in TFH.

Aside from the egg bank controversy, a friendlier disagreement arose, concerned with the naming of the new organization. The two main proposals advanced were: American Killifish Association and American Panchax Association. The problem with "Panchax," however, was that it was based upon a scientific name long since abandoned by the profession, and applied originally only to a very few fishes. The major objection to "Killifish" was the implication that these animals "killed" other fishes. Such logic however, when applied to fishes such as "tiger" barbs, tri-color "sharks," etc., quickly produced a *reductio ad absurdum*, and the Charter Committee voted overwhelmingly to select American Killifish Association as the official name.

The By-Laws of the AKA contained several novel features. A seven-man Board of Trustees was devised as the policy-making force for the Association. For continuity, three were elected in odd-numbered years, four in even-numbered years, and all served two-year terms (an early amendment to the By-Laws stipulated that Trustees had to take at least a one-year "vacation" before they could run again for office). Only members from the United States or Canada could vote or hold trusteeship office; foreigners were considered, of course, but the problems of conducting business via the mails among countries militated against it.

An important clause read: **" ...no more than two trustees of the seven shall reside in the same State in the case of the United States, or in the same Province in the case of Canada."** With one clause then, the new organization avoided the old problem of regionalizing or concentrating power in any one particular area, an occurrence that killed many a prior national aquarium organization. Perhaps even more important was Article VII "Mode of Operations," which stated: **"Insofar as it is applicable, the business of the Association shall be carried out by written correspondence."** Thus, in the AKA, any one could run for the Board of Trustees and expect to participate equally with other Trustees if elected. It was no longer necessary to be rich, retired or both to fulfill one's obligations as a Trustee. One did not have to travel, say, from Alabama to California to vote at a national convention or in vis-à-vis committees. A 6¢ stamp and a little time was all that was required. The By-Laws were adopted unanimously by the Charter Committee.

At the beginning of 1962, prospective members sent in $5.00 for their first year's dues, voted for seven Trustees and their choice of fish for the club emblem. Fourteen aquarists were nominated for Trustee, based upon recommendations received by the Charter Committee from interested aquarists during the latter part of 1961. In order that hobbyists would know who they were voting for, bibliographic sketches were prepared by the candidates, edited into a standard format by the Charter Committee and distributed to the voters. This is a commendable practice, still followed by the AKA. The choice of fish for the Association's emblem, by the way was closely decided between the Lyretail and the Blue Gularis, with the latter receiving the nod.

The details of the results of these first elections and the subsequent development of the AKA are to be found in the pages of the Association's publications (particularly *Killie Notes*) As I do not want to unnecessarily burden the reader (especially non-killy fans!) with such details, they will not be discussed here. Several general comments, however, might be helpful to other national aquarium organizations, extant or proposed. From the start, the AKA's publication program was a resounding success. *Killie Notes* (a professionally produced offset publication) came first. This was a mixture of topical club news and technical material. It was decided later to separate the two functions, and when the Association had sufficient funds, the publication was discontinued with two new ones taking its place: the *AKA Newsletter* and the *Journal of the American Killifish Association* (JAKA). Because the AKA depends so heavily upon the exchange of fishes and eggs among its members, a booklet entitled "Killifish Exchanges" was published soon afterwards. A host of other specialized publications appeared, the most important of which included a "Beginner's Guide" and the "Killifish Index." In short, the publication activity of the AKA has been extraordinary - no other aquarium organization has ever matched it. One of the most effective instruments for selling killifishes to the public and for recruiting new members proved to be the AKA's audio-visual (a slide-tape) program. Sight and sound told the Association's story and the story of killifishes. It was loaned free of charge to responsible hobby organizations.

One of the really vital activities of the AKA was, and still is, it's free (to members) egg and fish listings in its monthly newsletter. This enabled fanciers all over the world to obtain, exchange, and even sell many different species of killies. From a historical standpoint, however, two species of killies in particular spurred special interest in the hobby in the late 1950's and early 1960's. Indeed, they were partly responsible for the founding of the AKA in that they created general interest in the family. These species were *Aphyosemion filamentosum* and *Aphyosemion gardneri*, the former because it was a new, reasonably-sized and easily-bred "bottom spawner" (bottom spawners being relatively rare at the time); the latter also was an easily bred fish but in addition, it was a brightly-colored and exciting new "top-spawner" introduction. The AKA should really erect a monument to these two species! Another species important to the early AKA was the Blue Gularis. It was a natural "salesman" for the AKA!

The AKA has come a long way since 1961, and it has since seen the participation of many hobbyists from all over the world. In a sense, the new killifish hobby is quite different from the old killifish hobby when I can remember paying $10 for a pair of *Aphyosemion bivittatum* in the days when $10 was equivalent to $20 today. The species available to hobbyists nowadays would have simply amazed the hobbyists of a generation ago! Those of us, however, who were privileged to assist in the formation of this great organization almost 10 years ago will never forget those difficult but fascinating days of its birth; assuredly, we all treasure having had a chance to serve.

Comments on the Genus *Rivulus*

By Albert J. Klee

JAKA Vol. 15, Issue 3, pp.76-79, 1982

Members of the American Killifish Association have already been apprised of a new classification of cyprinodontiform fishes that has serious implications for how one views the relationships among them and for the definition of the term "killifish" itself (Parenti, 1981). Although it is my opinion that the classification should not be adopted by the American Killifish Association without substantial modification (which I will address at another time), this article deals only with the Parenti conclusions as they pertain to the genus *Rivulus*.

Parenti separates the genus *Rivulus* into two groups (see Table 1): *Rivulus*: which includes the type *cylindraceus* and other diminutive forms such as *marmoratus* and *heyei* and "*Rivulus*," which includes the type *hartii* and also *stellifer*. (By using the quotation marks, i.e., "*Rivulus*," Parenti is implying that the fishes included under this group will sometime in the future have to be transferred to another genus.) It is not clear what Parenti means by "other diminutive forms" since, although *hartii* is most likely the largest of all the *Rivulus* species, *stellifer* is no larger than *cylindraceus*. This is indicative of the carelessness shown throughout her work. The reader will note that I have "translated" Table

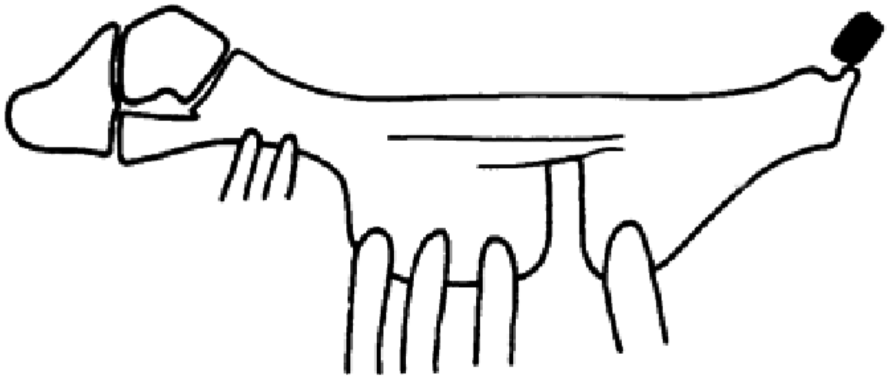

Figure 1: The hyoid bar of a Rivulus. The small dark object is the interhyal bone. (after Parenti, 1981)

1 to Table 2; this was necessary in order to examine the basis upon which she proposes that the two groups be separated.

Referring to Table 2, items (c) and (d) can be dealt with rather quickly. Anyone who has ever kept *Rivulus hartii* knows that there is no substantive difference in fin ray elongation between it and other species of *Rivulus* (excepting *Rivulus stellifer* which does have elongate pelvic fins). Garman (1895), for example, describes the pelvic fins of *Rivulus hartii* as "small." There are many excellent photographs available for aquarists to make this comparison for themselves (e.g., Innes, 1953, page 293). As for the number of pelvic fin rays, there is ample documentation to show that this number varies between 5 and 7 in *Rivulus hartii* (see Guenther, 1866; Garman, 1895; and Sterba, 1959), and between 6 and 71 in *Rivulus beniensis* (Meinken, 1971). Neither character, then, can be used to separate the two proposed groups.

The annual spawning habit of *R. stellifer* is well-documented (Thomerson and Turner, 1973) but there is no such indication that *R. hartii* spawns in this way. Parenti, however, "infers" an annual habit for this species. If, for the sake of argument, we were to assume that *Rivulus hartii* does, under certain conditions, reproduce in the annual mode, then it would have to be associated with some additional species that hitherto have not been associated with it. Although the Thomerson and Turner article stated that none of the then described species of *Rivulus* were true annuals, they overlooked an article (Lueling, 1971) that detailed the annual reproductive habit of *Rivulus beniensis.* (For a profile of this species and a description of its non-annual breeding habits, see Klee, 1963.) It may come as a surprise to some aquarists that many species of *Rivulus* are true "switch breeders," including some of those identified by Parenti as being non-annuals. I have had specimens of *cylindraceus* lay eggs on the bottom slate of a bare-bottomed tank; Hemker (1959) has described how he spawned *cylindraceus* using a bottom spawning grid, much in the manner of breeding zebra danios.

In any event, if annualism is to be a defining character for *"Rivulus," beniensis* must be included along with *hartii.* Furthermore, *Rivulus beniensis, Rivulus urophthalmus,* and *Rivulus micropus* have been observed fiving in the same natural waters as a true annual killifish, *Pterolebias peruensis* (Lueling, 1963). If one "infers" annualism to *hartii,* then there is an even stronger case for "inferring" annualism to *urophthalmus* and *micropus. Rivulus urophthalmus,* of course, is a well-known aquarium fish. Like *hartii,* however, it has never been observed to reproduce in an annual manner. This use of the annual character by Parenti to separate the genus *Rivulus* is somewhat puzzling in light of other statements she has made, e.g., "…the annual habit is no more than an exaggeration, due to extreme environmental fluctuations, of a capability of all cyprinodontiformes to survive stress that involves desiccation" (Parenti, page 364).

This leaves the matter of the differences in the interhyal bone. Since most aquarists likely are not familiar with this term, the bone is shown as the very small dark area in Figure 1. The figure shows the hyoid bar, which is part of the basic skeletal portion of the gill structure. Parenti found that, in all of the species she examined of the other genera of the family Rivulidae (which contains, in addition to *Rivulus,* the genera *Trigonectes, Neofundulus, Rachovia, Cynolebias, Pterolebias,* and *Austrofundulus),* the interhyal bone was cartilaginous, thereby concluding that some species of *Rivulus* are more closely related to these other genera than they are to others of their own genus. Since all non- *Rivulus* genera of the Rivulidae whose breeding habits are known as annuals, Parenti clearly was forced to "infer" annualism to *Rivulus harti* in order that her definition of *"Rivulus"* was consistent with the status of the other genera of the family Rivulidae. This seems somewhat unscientific in that it bends the facts to fit the theory.

Without additional supporting evidence, a bone this tiny is a rather shaky basis for splitting up the genus *Rivulus.* The argument for associating annualism with a cartilaginous interhyal bone is that, in annual fishes, sexual maturity may occur at vastly different times among individuals since growth is rapid and much dependent upon external factors such a food supply, temperature, water chemistry, etc. In such cases the process whereby bone is hardened may be delayed. However, the interhyal in *Fundulus confluentus* is ossified, yet it is no less an annual than are *Rivulus beniensis* and *Rivulus stellifer* in the matter of the ability of its eggs to survive long periods of desiccation (Klee, 1962). Shared structures based upon temporal environmental factors, therefore, do not necessarily imply common ancestry.

The genus *Rivulus* is a confusing and puzzling assemblage of approximately 60 species, many of them poorly described. A prior attempt to classify these fishes on the basis of the pattern of head scales (Hoedeman, 1961) has not been successful due to the fact that there is much individual variation in the named scale patterns. It is possible that the most ancient or basic rivulin may be an annual fish, and there are ichthyologists who believe that at least some rivulins, such as *Astrofundulus* and *Rachovia,* were derived from a *Rivulus-like* ancestor (Weitzman & Wourms, 1967; Taphom & Thomerson, 1978). Although the Parenti analysis is interesting, it appears that the problem of the classification of the genus *Rivulus* still remains a puzzle.

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WHAT'S IN A NAME? THE MEANING OF "KILLIFISH" PART I: The Origin Of The Word "Killifish"

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JAKA Vol. 16, Issue 1, pp. 2-12 1983

In 1624 the Dutch settled in the northeastern part of the United States bringing with them their own language, a bit of which has stayed with us throughout the years. The Dutch-derived word "kill" (from the Dutch "kil" or "kille") is a case in point. It is a word that has had, like most English words, somewhat different meanings at different times, including river channel (the word "Peekskill," for example, simply means "the channel of a citizen named Peek"), small waterway and stream. In New York State tributary streams feeding the Hudson River are still called kills, the Catskill (the original Dutch word was "Kaaterskil") being perhaps the most famous, and one only has to note the Kill van Kull which is a channel at the northern end of Staten Island connecting Newark Bay with Upper New York Bay.

Although the English took over this Dutch colony in 1664, isolated Dutch settlements in New York State still spoke Dutch exclusively during the 1700's and even up into the early 1800's. The Dutch tradition remaining strong, it was understandable that it became the custom of the English-speaking settlers to refer to the smallish, non-game fishes of the kills as "kill fish." In speaking of Fundulus heteroclitus, for example, De Kay (1842) wrote: "Its popular name is derived from its abundance in creeks and estuaries, which our Dutch ancestors termed 'kills' All sorts of small fishes were meant by this term including even minnows which, scientifically, are not related to present-day killifishes at all. (Conversely, many killies were known under the name "minnows"). The first written reference to American usage of the word appeared in a German account (Schoepff, 1788) where the word is spelled "Killfish" and refers to Fundulus heteroclitus. Johann David Schoepff (1752-1800), an army surgeon who was in this country during the revolutionary war, published in the Trans-actions of the Friends of Natural History at Berlin a memoir entitled "Descriptions of North American Fishes, chiefly from the waters of New York." This was for the most part a meager catalog of species, but Schoepff was a man of varied achieve-ments who authored several works relating to the natural his-tory of this country. As might be expected the spelling varied as it evolved, and we can find orthographic examples such as "killy-fish" (Herbert, 1849), "killefish" (Butler, 1858), "kill fish" or "killey fish" (Brown, 1876), "killia-fish" (Damon, 1879), and re settling down to the present-day accepted spelling of "killifish" (or, alternatively, shortened to "killy" or "killie" in the singular and "killies" in the plural). The word "killifish," by the way, is identified explicitly in Webster's New World Dictionary (Guralnik, ed., 1972) as the Americanism, i.e., a word modification that originated in and is peculiar to American English.

"KILLIFISH" AS A SCIENTIFIC NAME

It is may astound aquarists to learn that "killifish" has been used as a scientific name, to my knowledge a fact hitherto not brought to the attention of the aquarium hobby. When Schoepff wrote about "Killfish" in 1788 he also noted the use of two other common names, "Yellow-bellied Cobler" ("Cobler" being another word of Dutch origin), and "Mayfish." In 1792 the German naturalist Johann Walbaum described three species based upon Schoepff's descriptions: *Cobitis killifish*, *Poecilia macrolepidota* and *Cobitis majalis* for "Killfish," "Yellow- bellied Cobler" and "Mayfish," respectively. The word "*majalis*" was a Latinization of the word "Mayfish" but the word "killifish" was not translated. (The difference in one letter is attributable to the great variation in spelling at the time; "cobler," for example, was also spelled "cobbler.") The practice of using a vernacular name verbatim as part of a scientific name was not uncommon in the early days of ichthyology. In 1803, for example, Lacepede named *Fundulus mudfish* (a synonym of *Fundulus heteroclitus*), "mudfish" being the name used in South Carolina, the source of Lacepede's specimens. As it turned out, Walbaum's *Cobitis killifish* and *Poecilia macrolepidota* were synonyms for the subspecies *Fundulus heteroclitus macrolepidotus*. Nonetheless, killifish predates panchax as a scientific name by 30 years!

If readers are wondering about the generic names Walbaum used for these killifishes, it should be noted that the names Cobitis, Poecilia, and Fundulus all have a pre-Linnaean history. The first two were used for what passed as generic terms prior to 1758 (the date that binomial nomenclature has its recognized beginning) and were associated with various carps and loaches. Cobitis was used even after 1758. Alexander Garden (1730-1791), one of the earliest American naturalists, was a physician, residing in Charleston, South Carolina. Although his primary interest was botany (Gardenia was named in his honor), he was an enthusiastic collector of fishes and maintained a constant correspondence with Linnaeus, sending him specimens of fishes for description. His methods of preservation were so superior that a hundred years later almost all of the fishes sent by him to Sweden were still in existence. (His technique was to skin half of the fish, leaving the vertical fins attached, to press it in a botanical press, varnish it and glue it to a sheet of paper used by botanists to press plants.) One of the fishes he sent to Linnaeus was the one we presently know as *Fundulus heteroclitus* and, in 1766, Linnaeus named it *Cobitis heteroclita*. Garden had also supplied the information that the fish was known locally as "mudfish," hence the origin of the *Fundulus mudfish* of Lacepede. Turning now to the matter of "*Fundulus*" (meaning "of the bottom"), it was used only as a common or vernacular name, applied at first to certain bottom-dwelling cyprinids or carp-like fishes. Only in 1803 did it become a valid generic name (Lacepede again!), being thus transferred from fishes of the bottom to fishes of the surface.

PROFESSIONAL USAGE OF "KILLIFISH"

Dr. Samuel Mitchill (1764- 1831), a New York physician, started writing about fishes in 1814, beginning with those of the vicinity of New York City. His ichthyological communications were distributed through periodicals of every description, not even excepting weekly magazines and daily news-papers. Through his writings he documented the popular usage at the time of the term "killifish," in his own re-description of *Cyprinodon variegatus* in 1815, for example, he referred to it under the common name of "The Sheepshead Killifish." The first professionals to employ the word "killifish" in a very general sense, however, were the great American ichthyologist, David Starr Jordan and his long-time collaborator, Barton W. Evermann. The term appeared in their monumental "The Fishes of North and Middle America," Part I, which was published in 1896. The idea of supplying common names for fish families apparently originated with Jordan and Gilbert in 1882 when they published their "Synopsis of the fishes of North America." As was the custom of the time, Jordan and Gilbert lumped the livebearing forms (such as the mollies, swordtails and guppy) together with the egglaying forms (such as *Fundulus* and *Rivulus*) under the family name of Cyprinodontidae. Prior to 1911, the gonopodial structure and hence the great difference between the egglaying and livebearing cyprinodonts was not fully understood by ichthyologists. Since the family name they used was Cyprinodontidae, the logically referred to the members of the family as "The Cyprinodonts." In 1894, however, Gill argued that the family name Poeciliidae had priority. He also criticized the etymology of the word Cyprinodonts ("**...it expresses a taxonomic falsehood and even now constantly misleading persons.**"). Perhaps it was because of the latter, but for whatever reasons, Jordan referred to the Cyprinodontidae as "killifishes" in a natural history compendium published in 1885, the first known reference to the use of killifish as a general term to include all of the family. In their 1896 work, Jordan and Evermann switched to the name Poeciliidae but retained "killifishes" as the collective common name. In 1923 Jordan finally separated the cyprinodonts into two families, Cyprinodontidae and Poeciliidae, retaining "killifishes" for the former and adding "topminnows" for the latter. The decision to recognize two families was affirmed the following year by another distinguished ichthyologist, 15arl L. Hubbs, in his important reclassification of the cyprinodonts. Influenced by Hubbs, Dr. George S. Myers started to use the term "killifish" early in his professional work, restricting it to mean just the egglaying cyprinodonts. In 1924, for example, he wrote a paper entitled "On the existence of the Japanese killifish, *Fundulichthys virescens*, "a mystery" fish known only from a drawing (and which turned out not to be a killifish after all!). Myers' work is important to aquarists for he had been an avid hobbyist in the New York-New Jersey area during the period 1917-1924. This initiated a close association with the hobby that exists even to this day. He was the first to attempt to straighten out the nomenclatural errors that were prevalent in the early days of the hobby, even influencing such prominent German aquarists as Arthur Rachow. It should be noted that Dr. Myers revised every edition of Innes' famous "Exotic Aquarium Fishes" and so the nomenclature used (as well as that used in the Aquarium magazine during the time Innes was its editor) is due to him and him alone. All this plus the fact that one of his areas of specialization was killifishes make his work of great significance to the AKA.

The present-day usage of the term "killifish" by professionals is, in the main, fairly clear-cut. Lazara (1981) has suggested that "among professional ichthyologists, the term 'killifishes' is more broadly applied and includes livebearing forms..." This overlooks the fact, however, that for many years the American Fisheries Society (AFS), in a cooperative effort with the American Society of Ichthyologists and Herpetolo-gists (ASIH) operating through a joint Committee on Names of Fishes, has defined the term as did Jordan in 1923, and Hubbs and Myers in 1924 (see Robins, et. al., 1980). In AFS/ ASIH usage "killifish" means any member of the genera *Adinia, Crenichthys, Cyprinodon, Empetrichthys, Floridichthys, Fundulus, Jordanella, Leptolucania, Lucania* or *Rivulus*. It excludes all livebearers with the exceptions of *Heterandria formosa* and *Belonesox belizanus*. These exceptions are holdovers from the ignorance of the earlier days, circa 1895-1910. It may be that Lazara is referring to Dr. Donn E. Rosen of the American Museum of Natural History, who, in a major reclassification in 1964 involving killifishes, livebearers, silversides, and halfbeaks, used the term "killifish" to refer to both the livebearing and egglaying cyprinodonts as was done prior to 1923. Not everything that swims is a killifish, however, and the Rosen definition has certainly not been followed by the American Fisheries Society, the American Society of Ichthyologists, Herpetologists, nor, of course, by the AKA.

EARLY HOBBY USAGE OF "KILLIFISH"

Prior to World War II the Germans were the unchallenged leaders and trend-setters in the aquarium hobby. Since it was German aquarium practice to refer to the killies mostly as "eierlegende Zahnkarpfen" or "Eier ablaichende Zahnkarp-fen," so it was that the English translation of this German term ("egglaying toothcarps") came to be used as a catch-all for the group in this country. (I can almost see this question coming from readers: No, Dutch aquarists did not call them "killivissen"; they followed the German lead which, adapted to Dutch, is "eierleggende Tandkarpers"). In a catalog published in New York City by Walter Brind in 1913, for example, all of the killies listed are grouped under the general heading of "Toothcarp Group, Egg-laying fishes." However, American aquarists consistently referred to the American Fundulus forms and other North American egglaying cyprinodonts as "killifishes" ("top- minnows" was another popular term), as did Brind in a subheading in this 1913 catalog. An article in the November 1915 issue of the Brooklyn Aquarium Society's Bulletin titled, "The Killi-Fish," starts out as follows: "Our common Killi-fish, *Fundulus Heteroclitus*, some-times called the Zebra Killi-Fish, is a very interesting little creature and should be accorded a place in the aquarium." American dealers, looking for a less awkward name than "egg-laying toothcarps," began to use the term "killifishes" for the entire group. A Beldt's ad in the July 1930 issue of Aquatic Life, for example, listed all killies under this general heading. Furthermore, many books written in English frequently employed the term as a subtitle. In Rachow's "Tropical Aquaria- fish Catalog" published in 1927, for example, "killifishes" was used as a subtitle to "Egglaying Toothcarps." (In this, Rachow was influenced by Dr. Myers.) The one who first used killifishes as a main title (indeed, as the only title) was Christopher Coates in his "Tropical Fishes as Pets," published in 1933. The early (1930's) editions of William T. Innes' "Exotic Aquarium Fishes" used "killies" as a subtitle, but by the end of World War II subsequent editions used nothing but "The Killifishes" as a general heading.

THE ORIGIN OF THE TERM "PANCHAX"

It is now necessary to explore the origins of some very important scientific names associated with the killifish hobby, the first being panchax which first entered the scientific world in 1822 when the remarkable Scotsman, Francis Buchanan Hamilton, described a new species of cyprinodont from the environs of the river Ganges in India. The name he used was *Esox panchax*, "*panchax*" referring to a native name. The next important action occurred in 1839 when the genus *Aplocheilus* (pronounced AP-LOW-KYLE'-LUS) was established by the Scottish naturalist McClelland. McClel-land placed three fishes in the genus at the time, two of which were newly-described by him. These fishes were: *Aplocheilus chrysostigmus* (new), A. *melastigmus* (new), and Hamilton's *Aplocheilus panchax*. It was clear that Hamilton's species did not really belong in the genus Esox, a genus that contains certain North American and European game fishes such as the pike. (This was a legacy from the earlier days of ichthyology when, habitually, almost any slender pointed-snouted fish was placed into Esox. In 1815, for example, Mitchill had placed the Sheepshead killifish, *Cyprinodon variegatus*, into the genus *Esox*. McClelland did not name a type species for his new genus because the concept did not originate until about 1830 and was not common until 1880-1900. The idea of a type species reflects the desire of specialists in scientific nomenclature to have definite species as holdfasts for generic names. Ideally, a type species should be representative of the genus and of common occurrence. Its geographic distribution should be known and its taxonomic relationships established. In practice, of course, these conditions cannot always be met but in McClelland's case, the naming of a type species simply was not the custom at the time. This was doubly unfortunate since McClelland's genus *Aplocheilus* turned out to be a composite of two genera. In 1846 the famous zoologist, Louis Agassiz, proposed *Haplochilus* as an emendation (i.e., a minor but scholarly correction) of *Aplocheilus*. I should explain that "*Aplocheilus*" literally means "simple lip." The word for simple in Greek is "aplo," but the aspirate "a" becomes "h" and the "ei" in "cheilus" shortens to "i" in Latin. The present rules of the International Code of Zoological Nomenclature, which were not written until the 1890's, do not permit such emendations unless a clear case of typographical error is involved. Since there is no evidence of that such an error took place in McClelland's case, the emendation ultimately had to be rejected. The name *Haplochilus*, however, was used for many years before this was realized.

Next on the scene was Valenciennes (in Cuvier and Valenciennes, 1846) who, ignoring McClelland's genus *Aplocheilus* (probably because it was such a poorly defined composite) established the genus *Panchax* containing four species, among them *Panchax buchanani* which is a synonym of *Esox panchax* (Valenciennes renamed it because some people at the time objected to such repetition in a scientific name.) Thus *Panchax panchax* is the type species for *Panchax* because of a nomenclatural rule known as "absolute tautonymy" (i.e., if one of the species in a genus has the same name as the genus and if no type species was specifically named, then that species automatically becomes the type). It should be noted that the genus *Panchax* was even more composite than *Aplocheilus* since one of the species Valenciennes included in his new genus, *Panchax picta*, in reality was a species of Betta!

In 1963, the Dutch ichthyolo-gist Bleeker named *Aplocheilus chrysostigmus* as the type species for *Aplocheilus*. *A. chrysostigmus*, however, turned out to be a synonym of *A. panchax* and thus *A. panchax* is the type species of *Aplocheilus*. When two different genera have the same species names for their types, other things being equal, the older generic name is accepted. Accordingly, *Panchax* is a synonym of *Aplocheilus*. There is an interesting aside to this action of Bleeker in that it appears to be contrary to the results he had really intended. As I noted previously, the name *Aplocheilus* means "simple lip" but although the lip is simple in *Oryzias* species, it is complex in specimens of *Aplocheilus*. Thinking that *chrysostigmus* and *panchax* were two different species, Bleeker referred *Aplocheilus panchax* to the genus *Panchax*. If Bleeker had known the true facts he most likely would have declared *Aplocheilus melastigmus* to be the type species. Since *melastigmus* is one of the medakas presently in the genus *Oryzias*, both genera would have been valid and we would still have the genus *Panchax* in the killifish hobby today, at least for the Asian forms related to *Aplocheilus lineatus*.

USE OF SCIENTIFIC NAMES IN THE HOBBY PRIOR TO WORLD WAR II

In the early days of the aquarium hobby it was the custom of German aquarists to send specimens of new fishes to the British Museum of Natural History for identification. Heading the fish and reptile departments at the museum at the time was George Albert Boulenger. Boulenger was born in Belgium but as a young man was recognized by the great British ichthyologist, Albert Carl Guenther (the last person able to cover the entire fish fauna of the whole world), who induced him to come to London in 1881 where he gradually took over the master's work. Boulenger's specialty was the African fishes and, following Guenther's nomenclatural ideas, it was his custom to place nearly all of the African killifishes into two genera, *Haplochilus* and *Fundulus*, the latter for those with the dorsal fin origin above or before that of the anal fin, and the former for those with the dorsal fin origin behind that of the anal fin. As a consequence the emended version of *Haplochilus* was applied in the aquarium hobby to many Asian and African killifishes. In the 1913 Brind catalog alluded to earlier, the "Egg-laying Tooth-carps" were divided into three groups: (1) The "*Haplochilus* Family" (present-day *Aphyosemion, Epiplatys*, and *Aplocheilus*), (2) The "*Rivulus* Family" and (3) The "*Fundulus* Family" (the American *Fundulus* and *Lucania* were listed). This picture changed, however, as other ichthyologists entered the scene. In order to follow this sometimes complex history, Table 1, which deals with the major genera involved (but not all, e.g., *Procatopus*) is offered to make things easier. The table is only approximate since usage was not always uniform, but it presents a fairly accurate overall picture.

It can be seen from Table 1 that the "Boulenger era" lasted approximately from 1905 to 1924. As was previously noted, both the present day *Nothobranchius* and *Fundulopanchax* (by the latter I mean the mostly annual *Aphyosemion*-types distinguished by an elongate dorsal fin of 14 rays or more, such as the blue gularis) were placed by Boulenger in the North American killifish genus *Fundulus*. Thus, during the period 1905-1924, the African and Asian killies were known in the hobby primarily under the scientific names of *Haplochilus* and *Fundulus*.

In 1921, a young German ichthyologist finally became interested in aquarium fishes. This was Dr. Ernst Ahl, who became Director of the departments of Ichthyology and Herpetology at the Zoological Museum of the University of Berlin. He was an avid aquarist, holding the editorship of Das Aquarium from 1927 to 1934. (This brilliant career, however, ended on an ugly note when Ahl became an ardent Nazi. He neglected his work, became embroiled in political contro-versies with other scientists and otherwise caused considerable difficulties for the Museum. In spite of the fact that it was exceedingly dangerous to proceed against one with such political connections, discipli-nary action was initiated by the Museum authorities and when indictments of a serious nature were threatened, Ahl voluntarily joined the Schultzstaffel (SS) and ultimately was shot by Yugoslav partisans during the war.) In 1924 Ahl started to use the name *Panchax* for the *Haplochilus* genera we now know as *Aphyosemion, Panchax, Epiplatys* and *Aplocheilus*. Also in this year Myers introduced the new generic name, *Aphyosemion*, and the subgeneric names *Fundulopanchax* (for the large-finned *Aphyosemion*-types) and *Adiniops* (for certain of the *Nothobranchius*). The reaction in the hobby was interesting. Firstly, *Panchax* was immediately accepted by aquarists without much question for the genera that we now know as *Pachypanchax, Epiplatys* and *Aplocheilus*, but Myer's *Aphyosemion* was generally used instead of *Panchax*. (A few aquarium writers reported *Aphyosemion* under the name *Panchax* but this was not a widespread practice.) Secondly, Myers' proposed subgenus, *Fundulopanchax* (and, to a lesser extent, *Adiniops*) started to appear in the aquarium literature elevated to full generic status.

In 1933 Myers published a paper that clearly defined the differences between the African and Asian *Panchax* types; accordingly the next changes occurred when the names *Pachypanchax* and *Epiplatys* started to appear in the aquarium hobby literature (starting in 1934 and 1935, respectively). The use of *Adiniops* was also discouraged in this paper and from 1933 on, *Nothobranchius* was the term predominately used for these annual fishes. By 1938 the situation regarding *Panchax* and *Aplocheilus* was realized by many ichthyologists, and towards the end of 1938 the *Aquarium* magazine stopped using the former in favor of the latter. The 1938 edition of "Exotic Aquarium Fishes" was the last of the editions to use the name *Panchax* as a scientific name. World War II slowed things down somewhat, but after the war ended the transition away from *Panchax* as a scientific name in the hobby literature was virtually completed both here and in Germany.

It should be noted that the above discussion refers to Old World killifishes only. *Panchax* was not applied by the hobby to the New World killifishes, the main genera *Rivulus* and *Cynolebias* generally being used correctly both here and abroad. The main reason for this was that, after 1910, Boulenger confined his fish work to Africa and left the identification of American and Asian fishes to his young colleague, C. Tate Regan, a man who later was to be considered by many to be the world's foremost living ichthyologist.

USE OF THE TERM "PANCHAX" IN THE HOBBY AFTER WORLD WAR II

Although it is true that a "Panchax Group" was identified in the early editions of Innes' "Exotic Aquarium Fishes," this referred only to the genera *Panchax* (= *Aplocheilus), Epiplatys*, and *Pachypanchax*; the term "*Panchax*" was never used to refer to the killies as a whole in this book. In any event, by 1940 Innes had stopped using the term "*Panchax*" both as a scientific and as a popular term in his publications. Considering the strong influence his publications had upon the American aquarium hobby and in view of the fact that "*Panchax*" clearly has little merit whatsoever as a general term for the killifishes, it might be wondered why it persisted on the American scene for so long a time. Part of the blame can be placed on dealers who continued to use *Panchax* for convenience, a practice that started in the early 1930's.

After Innes retired as editor of the Aquarium magazine, the editorship passed into the hands of Alan Fletcher. In 1958 Fletcher announced the formation of "The American Panchax Association," explaining that "A more accurate name for the group would be killifishes, but we feel that '*panchax*', although not so exclusive, has much more meaning for most hobbyists." The American Panchax Association, however, was a failure (for reasons I will not go into here) and died stillbirth. (The current organization of the same name has no relationship to this early attempt.) In December 1959 Helen Simkatis assumed the editorship of the Aquarium magazine and, simultaneously, the magazine started a monthly column called "The Panchax Exchange." Between dealer usage and this column, the name "*Panchax*" became the de facto term for most American hobbyists.

In June 1961, however, Robert Criger and I founded the American Killifish Association. (The date of August 1961 cited in my article on the history of the AKA that appeared in the January 1971 issue of the Aquarium magazine was a typographical error that occurred in transcribing the original manuscript.) A letter dated June 22, 1961, from Criger to me, is the earliest written reference there is to the AKA. The letter actually refers to the "International Killifish Association" because Bob and I originally thought in terms of a much wider-based organization. This decision, however, was made before I wrote the first By-laws of the AKA. These By-laws restricted all official business of the Association to written correspondence, an innovation at the time. However, it was not thought possible, given the relative slowness of international mail, to conduct business in a timely manner world-wide using this system. Accordingly, I proposed to the Charter Committee that the name of "American Killifish Socia-tion" be adopted. The Charter Committee was formed in July 1961 and consisted, in addition to Bob and myself, of 5 aquarists of national reputation who were invited to help us get the AKA on its way. From August 1961 on, all decisions regarding the fledgling organization were made by this committee. The decision regarding the name of the organization was not without some (friendly) controversy, however. George Maier (a finer man I have never met in the aquarium hobby and a mainstay of the Association) argued strongly for the use of the name "Panchax" mostly because he feared that beginners would interpret the name to mean "killer" fishes. I had some sympathy with George's views but the uniquely American origin of "killifish" won the day. Much to my surprise, (but also deep satisfaction), the British soon after adopted the term, then the Germans, to where now it is almost universally used. Thus any hobbyist using the term "*Panchax*" these days to refer to killifishes is not just out-of-date, but is out-of-step with the rest of the world as well.

To be continued…

TABLE I
APPROXIMATE DATES OF AQUARIUM USAGE OF SCIENTIFIC NAMES FOR OLD WORLD KILLIFISHES PRIOR TO WORLD WAR II

INCORRECT NAME CORRECT NAME	*Haplochilus*	*Fundulus*	*Adiniops*	*Panchax*
Aphyosemion[1]	1905-1924			
Aplocheilichthys	1905-1924			
Fundulopanchax[2]		1905-1924		
Nothobranchius		1905-1924	1924-1932	
Pachypanchax	1905-1924			1924-1934
Epiplatys	1905-1924			1924-1935
Aplocheilus	1905-1924			1924-1938

Notes:
1. From 1924-1932, a few aquarium writers reported *Aphyosemion* under the name *Panchax* but this was not a widespread practice.
2. After 1933, fishes of this genus were often included in the genus *Aphyosemion*. Since this is a matter of opinion, I do not consider it to be an error here.

What's In A Name?
The Meaning of "Killifish"
Part II

Albert J. Klee, Ph.D.
JAKA Vol. 16, Issue 2, pp. 37-55, 1983

Classification vs. Nomenclature

In the course of pursuing a definition of the term "killifish" I have discussed the history of the generic names *Aplocheilus* and *Panchax* in particular, and two others in passing. Along the way it was necessary to consider certain of the rules of zoological nomenclature in order to understand why *Panchax* is not considered a valid scientific term. Zoological nomenclature is merely a standard way of labeling the units used in classification; it has no other function. It is a very complex, formal, and rigidly legalistic system as exemplified by the type species rule that affected the status of *Panchax.* At times the application of the rules of zoological nomenclature itself creates some instability (e.g., the name change, after 57 years of hobby usage, of *Epiplatys chaperi* to *Epiplatys dageti)* but the fact is that without such rules there would be nothing but chaos. As Simpson (1961) states: "Scientists do tolerate uncertainty and frustration because they must. The one thing they do not and must not tolerate is disorder." Like every other responsible party, therefore, the AKA must play the nomenclatural "rules game."

If zoological nomenclature is the application of distinctive names to each of the members recognized in any given zoological classification is the zoological classification is the ordering of animals into groups on the basis of certain relation-ships. It is not possible, however, to devise a practicable nomenclatural system that is independent of at least some ideas of classification. Suppose, for example, that the goal was simply a "filing system." As readers well know, to find something in a filing system it is necessary to be able to sort things. However, one needs a basis for sorting, i.e., concepts of classifications. The Zip-code system of the Postal Service is a case in point. If the goal of the Postal Service had merely been to associate a unique Zip-code number with every community in America, then one could have assigned the numbers randomly to the communities. Just looking at a randomly-assigned Zip-code number, however, would not provide any clue as to where the community was located. The actual Zip-code system, of course, is based upon a specific classification concept, i.e., that numbers can be ordered according to their magnitude. Anyone looking at a Zip-code number whose first two digits are 10, for example, knows immediately that it refers to a community located on the east coast and not one in California.

One approach to the classifications of fishes, known as "phenetics" or "mathematical or numerical taxonomy" (taxonomy or systematics is the study of classification), is based upon a mathematical measure of the similarity of characters. (In this system the characters must be either measurable or countable.) The information is fed into a computer and, according to sundry statistical or mathematical programs, measures of similarity or dissimilarity are computed that serve as a basis for the classification. For example, suppose we measure eye diameter and the ratio of head length of three groups of killifishes; the data might appear when plotted as shown in Figure 1. The distances between the "centers of gravity" of the three clusters of points representing the fishes could be taken as an index of similarity (the distances are shown as the triangle in the figure). Furthermore, by a statistical procedure (called "discriminant analysis") the dashed line in Figure 1 can be established to clearly differentiate between Group A fishes and Group B

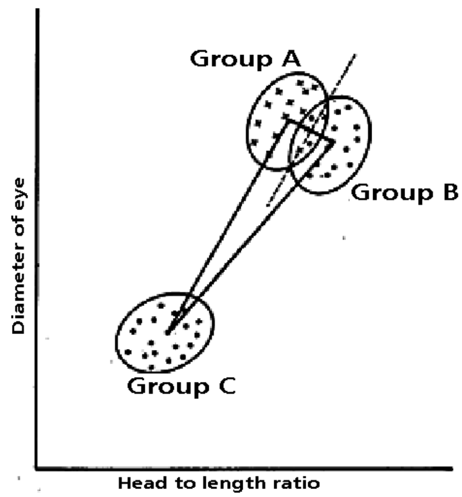

Figure 1: A mathematical approach to classification.

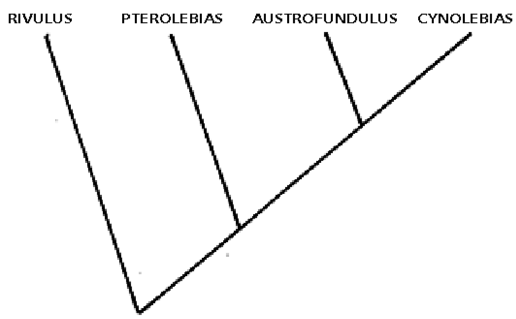

Figure 2: A cladistic approach to classification.

fishes. (In this example, certain members of both groups would have to be re-classified.)
Another approach, known as "phylogenetic taxonomy" or "cladistics," attempts to construct branching relationships called a "cladogram" ("klados" in Greek means "branch"). To understand the concept it is necessary first to define the idea of a "sister group". Two lineages sharing a common ancestor from which no other lineage has sprung form a sister group (Gould, 1981). For example, *Cynolebias* and *Austrofundulus* form a sister group because it is hypothesized that no other fishes branched from their common ancestor. The cladogram is formed by a series of either-or or "dichotomous" questions. Taking the "cynoaustro" sister group as a unit, we ask ourselves which genus forms a sister group with it. The answer is *Pterolebias* since *Pterolebias, Austrofundulus,* and *Cynolebias* all had a common ancestor. Taking the "ptero-cyno-austro" group as a unit we then ask which genus forms a sister group with it. The answer is *Rivulus* since all four genera had a common ancestor. The result is the cladogram shown in Figure 2 that could serve as the basis for a classification. It is, in fact, a part of a real cladogram taken from a recent classification of the killifishes.

The third approach is known as "evolutionary or traditional taxonomy." The traditional taxonomist groups his fishes accordingly to similarities (like the numerical taxonomist) and arranges them into a hierarchy (like the cladicist). Unlike the cladicist, however, the traditionalist is not constrained into accepting the evolution of fishes as being forced into "either-or" pathways (Foster, 1982). In Figure 3, for example, three genera of fishes originate from one node. Unlike the approach of the numerical taxonomist the similarities are often qualitative, not quantita-tive, as least at classification levels above that of the species. The traditionalist example of Figure 3 is part of an actual classification of killifishes devised over 50 years ago. Note that it is based upon such characters as the presence or absence of a protractile upper jaw and certain teeth, and the relative placement of the pectoral fins.

All three approaches involve certain characters or attributes of a fish. The cladicist argues that there are two basic types of characters, i.e., "primitive" and "derived." Derived characters are defined as features present only in members of an immediate lineage. In the cladogram of Figure 2 the genera *Austrofundulus* and *Cynolebias* share an enlarged spine on the first vertebra; the others do not. *Pterolebias* forms a sister group to the other

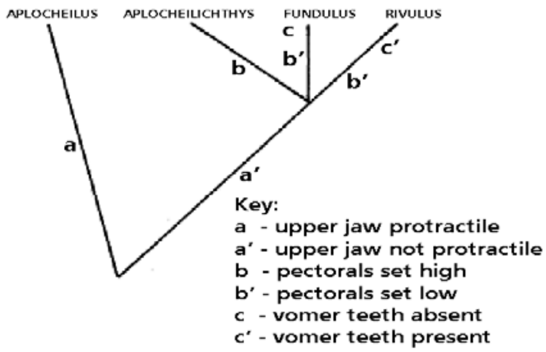

Figure 3: A traditional approach to classification

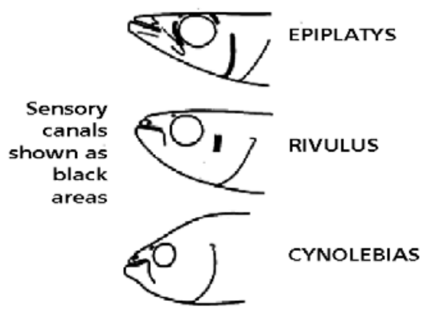

Figure 4: Sensory canals in some killifishes (after Parenti)

two genera because all three genera have elongated pectoral fins. *Rivulus* forms a sister group to the other three genera because they all either lack or weakly display sensory canals on the head. (Figure 4 compares the head sensory canal patterns of two of these genera with that of *Epiplatys,* a genus from a different lineage.) The characters used in the traditionalist classification shown in Figure 2 would be termed "primitive" by the cladicist since they are found in. other lineages as well.

Classification As An Additional Source Of Instability In Killifish Names

Since the time of Linnaeus there has been an enormous increase in the number of classification units such as subgenera, genera, families, etc. Some classifiers, known as "splitters," tend to recognize many numbers of such units; others, known as "lumpers," recognize fewer numbers. It is important to understand that although the rules of nomenclature require us to accept certain "decisions regarding killifish names, they do not force us to accept the decisions of either lumpers or splitters. For example, suppose I write an article for JAKA and propose that the genus *Rachovia* be split up into two genera, *Rachovia* and *Pseudorachovia,* simply on the basis of size (all those under 3 inches standard length go into the new genus). If I write the article properly, the new name of *Pseudorachovia* would be a valid generic name under the rules of zoological nomen-clature. However, no one is forced to accept these new names. AKA members can "take them or leave them" as they see fit. An interesting sidelight on the ease of naming genera is the case of Axelrod who, in 1971, apparently established the cichlid genus, *Microgeophagus,* without even knowing it (Robbins and Bailey, 1982).

In light of the fact that it is exceedingly easy to introduce new names for classification units other than species, I am constantly amazed how quickly hobbyists accept newly-proposed names. No sooner than the proposal appears in print then an article appears in the hobby literature announcing a "name change." On the cichlid side of things, for example, *Pelvicachromis* and *Papiliochromis* were accepted with unseemly speed and without critical appraisal. Some of our friends in the British Killifish Association have elevated the Clausen subgenus *Pseudepiplatys* and the Huber and Seegers subgenus *Diapteron* to full generic status (Killi-News, No. 164, April, 1979, and No. 189, May, 1981, respectively); in the reverse direction, many German and English hobbyists have followed Scheel's 1972 proposal in treating the genus *Epiplatys* as a subgenus of *Aplocheilus* (a partial reversion to the Boulenger days). Fortunately the AKA has been relatively conservative, at least with regard to new generic adoptions, a course of action I applaud and hope will continue.

Proposal For An Official AKA Killifish Classification

To what extent should new ideas influence how the AKA views the concept of a killifish and the interrelationships among the various kinds? I certainly do not agree with the LIFO or "Last In, First Out" accountancy approach that the AKA accept that which has appeared in the most recently published refereed journals; it is precisely that point of view that has been responsible for many of the nomenclatural problems that have plagued the hobby in the past. A consistent LIFO policy for the AKA would have resulted in the adoption of Col. Scheel's views on the genus *Aplocheilus* ten years ago since his proposal was published in a refereed journal of considerable repute. The AKA, however, continues to use the genus *Epiplatys.* One cannot have it both ways. In any event, such decisions are far too important to default to outsiders or, for that matter, to unilateral decisions made by individual members of the AKA.

Since I, for one, do not want my lampeyes classified with the mollies any more than I want my lungfishes classified with the sparrows, I suggest that the AKA establish its own official classification, based upon professional opinion of course, but biased in a way that best serves the AKA. This means:

a. The basis of the classification should tend to favor the most biologically significant (to hobbyists) relationships among the fishes;
b. The classification should be consistent; and
c. The classification should be as stable as possible without violating the above two principles.

By "biologically significant to hobbyists" I mean giving more weight to attributes such as interbreeding, external appearance and zoogeography; by "consistency" I mean avoiding splitting in one genus and lumping in another; and by "stable" I mean that we take a

TABLE 2: MYERS 1931 CLASSIFICATION (FAMILY CYPRINODONTIDAE)

CYPRINODONTINAE	FUNDULINAE		
Aphanius	TRIBE	TRIBE	TRIBE
Cyprinodon	Fundulini	Rivulini	Aplocheilichthyini
Floridichthys			
Jordanella	Adina	Adiniops	Aplocheilichthys
Tellia	Chriopeops	Aphyosemion	Cynopanchax
	Cubanichthys	Cynolebias	Hypsopanchax
	Empetrichthys	Cynopoecilus	Plataplochellus
LAMPRICHTHYINAE	Fundulus	Fundulosoma	Pachypanchax
	Leptolucania	Neofundulus	Procatopus
Lamprichthys	Lucania	Nothobranchius	
	Oxyzygonectes	Panchax	
	Plancterus	Pterolebias	
ORESTIATINAE	Profundulus	Rachovia	TRIBE
	Valencia	Rivulichthys	Aplocheilini
Orestias		Rivulus	Aplocheilus
		Trigonectes	

conservative view and expose radical proposals to the judgment of time before we advise our members to adopt them. Like any other set of principles I realize that they might be difficult to achieve in practice. An effort must be made, however, for the AKA to exert its influence to try to introduce more stability into killifish nomenclature. For a start, I propose that the AKA consider the killifish classifica-tion system shown in Table 4 (it contains elements of both Myers and Parenti) and, for the moment, to define "killifishes" as all egglaying members (save *Tomeurus)* of the order Cyprinodontiformes. I appreci-ate the fact that certain genera (especially *Aphyosemion, Nothobranchius, Epiplatys, Fundulopanchax* and *Aplocheilichthys)* pose problems, but as a true professional consensus emerges with time changes can be made as are necessary and reasonable. Some aquarists might raise their eyebrows at the inclusion of the perhaps unfamiliar genus *Fundulopanchax* in this proposed classification but a splitting of the genus *Aphyosemion* has been accepted by the AKA in the past in the form of *Roloffia*. Furthermore, *Fundulopanchax,* as

TABLE 3: MYERS 1955 CLASSIFICATION (FAMILY CYPRINODONTIDAE)

FUNDULINAE	CYPRINODONTINAE	PROCATOPODINAE	RIVULINAE
Adina (4)	[Anatolichthys]	Aplocheilichthys (7)	Adanas (1)
Fundulus (4)	Aphanius (9)	[Congopanchax]	Aphyosemion (1)
Leptolucania (4)	Cualac (9)	Cynopanchax (7)	Aplocheilus (1)
Lucania (4)	Cyprinodon (9)	[Hylopanchax]	Epiplatys (1)
Plancterus (4)	Floridichthys (9)	Hypsopanchax (7)	[Fundulosoma]
- - - - - - - - - - - -	Jordanella (9)	[Micropanchax]	Nothobranchius (1)
Profundulus (3)	Kosswigichthys (9)	Plataplocheilus (7)	Pachypanchax (1)
- - - - - - - - - - - -	Megupsilon (9)	[Platypancbax]	- - - - - - - - - - - - - - -
Valencia (5)	[Tellia]	[Poropanchax]	Austrofundulus (2)
- - - - - - - - - - - -		Procatopus (7)	[Campellolebias]
Oxyzygonectes (6)			Cynolebias (2
Crenichthys (8)	ORESTIANINAE	PANTANODONTINAE	[Cynopoecilus]
Empetrichthys (I)	Orestes (9)	Pantanodon (7)	Pterolebias (2)
[Chriopeoides]			Rachovia (2)
Cubanichthys (9)	LAMPRICHTHYINAE		[Rivulichthys]
	Lamprichthys (7)		Rivulus (2)
		ORYZIATINAE	[Simpsonichthys]
		Oryzias	[Terranotus]
			Trigonectes (2)

Note: Genera In brackets are those considered by Parenti as not valid. The subfamily Oryziatinae was removed from the killifishes by Rosen In 1964.

ABBREVIATED PARENTI CLASSIFICATION, 1981 (ORDER CYPRINODONTIFORMES)

SUBORDER APLOCHEILOIDEI
(1) APLOCHEILIDAE
(2) RIVULIDAE

SUBORDER CYPRINODONTOIDEI
(3) PROFUNDULIDAE
(4) FUNDULIDAE
(5) VALENCIIDAE
(6) ANABLEPIDAE (Anablepinae + Oxyzygonectinae)
(7) POECILIIDAE (Poeciliinae + Fluviphylacinae + Aplocheilichthyinae)
(8) GOODIDAE (Goodeinae + Empetrichthyinae)
(9) CYPRINODONTIDAE (Cubanichthyinae + Cyprinodintinae)

I have explained, is a very old name in the killifish hobby, and *Roloffia* is an invalid name under the rules in any event. Although I am not particularly enamored of the inclusion of the subgeneric names noted in the proposed classification, they are helpful in breaking down larger groups for special purposes such as shows; furthermore, changes at the subgeneric level do not cause the nomenclatural instability that changes at the specific or generic level do. An alternate proposal is that "killifishes" be defined as all egglaying members (save *Tomeurus)* of the order plus the family Goodeidae. Many members of the AKA keep goodeids already and by officially incorporating them into the definition (which poses neither historical nor scientific problems), these interesting fishes could be introduced to other members and their distribution accelerated in the hobby. If the goodeids are accepted by the AKA officially as killifishes, then the following seventeen genera should be listed in Table 4: *Allodontichhys, Allotoca, Alloophorus, Ameca, Ataeniobius, Charcodon, Chapalichthys, Girardinichthys, Goodea, Hubbsina, Ilyodon, Neoophorus, Skiffia, Xenoophorous, Xenotaenia, Xenotoca,* and *Zoogoneticus.* Cox (1982) makes a plea for including certain fishes, presently not sanctioned by the AKA, in any official AKA definition of killifish, opining that "....if the end result of such inclusion would be a list that isn't scientifically 'neat', I would suggest not (to) lose any sleep over it; no one expects perfection from a group effort... " Perfection, of course, lies in the eye of the beholder; nevertheless, Tim Cox makes a good point.

Classifications of Killifishes

The classification that is used is an extremely important factor in the definition of the word "killifish." Although many ichthyologists, such as Garman, Regan, Jordan, and Hubbs, have played an important role in the early major classifications of the killifishes, the first significant classification whose basic elements are still used today was that of Myers (1931), shown in Table 2. In 1955 Myers published a revision but the major differences between the 1931 and 1955 versions are mostly found in the elevation of tribes to subfamilies, an example of the trend I have just mentioned. In both cases, however, the definition of "killifish" was simple, i.e., any member of the family Cyprinodontidae. Tim Cox, writing in the July 1982 issue of Tropical Breeze, suggests that the AKA's By-laws officially define the word "killifish" for the organization. The By-laws, however, simply equate "killifishes" with the family "Cyprinodontidae" without defining the latter. When I wrote the original By-laws I had in mind the 1955 Myers classification, but this is nowhere stated "officially." Tim Cox has a good point, however, and highlights a deficiency I propose the AKA remedy.

The Myers classifications are examples of the traditionalist school. Recently, a new classification has been proposed (Parenti, 1981), using a cladistic approach, that makes it advisable for the AKA to reconsider the definition. With some apologies for the complexity of Table 3, I have added numbers and dashed lines to the Myers 1955 classification, supplied the genera that are commonly included in the subfamilies, and have appended an abbreviation of the Parenti classification below it. (The full Parenti classification was presented by Ken Lazara in the Sept./Oct. 1981 issue of JAKA; it need not be repeated here.) This was done so that readers can appreciate the differences (at times violent) between the two systems. The dashed lines in the Myers classification show how Parenti proposes splitting the Myers subfamilies and the numbers show where, under the Parenti system, the genera are placed. Many of the differences are due simply to splitting. Myers' subfamily Fundulinae, for example, is (excluding the genus *Cubanichthys)* split into 5 families. Some really revolution-ary changes, however, include: *Oxyzygonectes,* a fish formerly allied with the genus *Fundulus* is now associated with the four-eyed fishes; the African lampeyes are placed into the same family as the aquarium livebearers (mollies, platies, etc.); and the Turkish killifish genus *Kosswigichthys,* the Southern European genus *Aphanius,* and the genus *Orestias* from Lake Titicaca in the Andes are all united in the same assemblage as the American flagfish and North American *Cyprinodon* species. This illustrates some of the problems with the cladistic approach. As Gould (1981) puts it, "I regret to report that there is surely no such thing as a fish. About 20,000 species of vertebrates have scales and fins and live in water but they do not form a coherent cladistic group. Some - the lungfishes and the coelacanth in particular - are genealogically close to the creatures that crawled out on land to become amphibians, reptiles, birds, and mammals. In a cladistic ordering of a trout, a lungfish, and any bird or mammal, the lungfish must form a sister group with the sparrow or elephant, leaving the trout in its stream."

No system is perfect, however, and aquarists should not be misled into thinking that one approach is better than the other. Both at times involve judgments, guesses and arbitrary decisions. As Foster (1982) has pointed out, Parenti made a conscious decision to examine bone structure in great detail, rather than chromosomal characteristics and other attributes for which data are not as readily attainable. (For other critical comments on the Parenti work see Klee, 1982.) Furthermore, although a great deal has been made of the differences between them, one man's "primitive" is often another man's "derived" character. There is no difference between a primitive character and a derived character *per se.* Derived characters are not restricted to "hard anatomy" such as bones; mode of reproduction, pigmentation of males, and shape of the tail fin, for example, serve as derived characters in certain parts of Parenti's

TABLE 4: PROPOSED AKA CLASSIFICATION (ORDER CYPRINODONTIFORMES)

APLOCHEILIDAE
Adamas
Aphyosemion
  (Archiaphyosemion)
  (Chromaphyosemion)
  (Diapteron)
  (Kathetys)
  (Mesoaphyosemion)
Aplocheilus
Epiplatys
  (Lycocyprinus)
  (Parepiplatys)
  (Pseudepiplatys)
  (Aphyoplatys)
Fundulopanchax
  (Callopanchax)
  (Paraphyosemion)
  (Paludopanchax)
  (Raddaella)
  (Gularopanchax)
Nothobranchius
Pachypanchax

VALENCIIDAE
Valencia

RIVULIDAE
Austrofundulus
Cynolebias
Neofundulus
Pterolebias
Rachovia
Rivulus

OXYZYGONECTIDAE
Oxyzygonectes

PROFUNDULIDAE
Profundulus

FUNDULIDAE
Adinia
Fundulus
Leptolucania
Lucania
Plancterus

ANABLEPIDAE*

JEHYNSIIDAE*

POECILIIDAE*

GOODEIDAE*

APLOCHEILICHTHYIDAE
Aplocheilichthys
  (Micropanchax)
  (Lacustricola)
  (Congopanchax)
  (Poropanchax)
Cynopanchax
Fluviphylax
Hypsopanchax
Lamprichthys
Pantanodon
Plataplocheilus
Procatopus

EMPETRICHYIDAE
Crenichthys
Empetrichthys

CYPRINODONTIDAE
Aphanius
Cualac
Cubanichthys
Cyprinodon
Floridichthys
Jordanella
Kossigichthys
Megupsilon

ORESTIAIDAE
Orestias

Names in parentheses denote subgenera; asterisks indicate families of livebearing fishes whose genera are not listed here.

classification of the killifishes. The truth of the matter is that adequate data are hard to come by in ichthyo-logical research of this nature and competent professionals will use any valid data they can lay their hands upon. Although both Foster (1982) and Lazara (1981) have given short shrift to the approach of the numerical taxonomists, there is certainly a place in classification for mathematics. The numerical taxonomist can use "derived" characters as well as "primitive" ones. A numerical approach, moreover, more readily accommodates the idea of a species (and, by extension, genera and higher classification units) as the variable unit that it is observed to be in the real world. A good example is the sensory canal character chosen by Parenti as a primitive one (Figure 4); it is not "either-or" since *Rivulus* retains some vestige of the canal network. Ironically, there is a great deal of mathematical and statistical treatment (in the form of frequency distributions and indices) in the Rosen (1979) paper on *Xiphophorus* and *Heterandria* that served as a virtual model for the Parenti work. The differences among approaches, therefore are more often apparent than real. All this aside, however, any classification may have merit, depending upon the purpose the classification is to serve. As Simpson (1961) puts it, "We must thus accept the possibility and in fact the need not only of many classifications but also of many kinds of classifications, that is, of classifications based on different sorts of relationships and serving different purposes." Or, to return to Gould for a last time, "**The cladogram of trout, lungfish and elephant is undoubtedly true as an expression of branching order in time. But must classifications be based only on cladistic information? A coelacanth looks like a fish, tastes like a fish, acts like a fish, and therefore - in some legitimate sense beyond hidebound tradition - is a fish.**"

Last Word

If any brief summary can be made of this exploration of the word "killifish" it is that, with regard to both the scientific and popular names that we as aquarists use, it is partially a science but also partially an art form composed of equal parts of taste, tradition and usefulness. Since our primary reason for association is the love of nature and of fishes in particular, we might remember not to take ourselves too seriously. To paraphrase a well-known Englishman, "**What's in a name? That which we call a killifish by any other name would afford no less pleasure.**"

Acknowledgements

I would like to thank Dr. George S. Myers who provided generously of his time to review this manuscript in great detail and who made numerous invaluable suggestions for its improvement.

Any errors, however, are my responsibility and mine alone. Dr. Robert R. Miller assisted me in a question I had regarding *Garmanella,* the gist of which is that although Lynne Parenti has synonymized *Garmanella* with *Jordanella,* Julian Humphries thinks *Garmanella* should be synonymized with *Floridichthys* and plans to do just that in a forthcoming paper. Dr. Jamie E. Thomerson was kind enough to help with a question I had regarding the synonymizing of *Terranatus* with *Cynolebias,* and Dr. Bruce Turner assisted in the compilation of the valid genera of the goodeids. With regard to that letter, Bruce advises AKA members **"...not to become too fond of the generic names *Neoophorus, Xenoophorus, Xenotoca* or *Ameca.*"** Apparently the name-change game is afoot again. Incidentally, with his characteristic sense of humor, Bruce remarks: "**There is another goodeid genus that does not appear on your list. It is *Tapetia* Alverez & Arreola 1972. However, since it is known only as a Mio-Pliocene fossil, I don't think it would interest AKA members ... I am reliably told that it is a *Skiffia* anyway.**"

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A History of the American Killifish Association

By Albert J. Klee

JAKA/KN Vol. 23, Issue 2, pp. 53-60,1990

It would, in my view, be wrong to dismiss this brief chronicle of the American Killifish Association simply on the grounds that one is not par-ticularly interested in killifishes. The fact of the matter is that the AKA has been the most successful aquarium organization in the history of the hobby anywhere in the world, bar none. It is, therefore, relevant to any aquarist interested in hobby organizations, how they get started, what makes them tick and how they prosper. It is primarily for these reasons that this history is now put to paper.

The AKA was not the first serious attempt to formulate a killifish organization of at least national scope. Several years prior to the launch-ing of the AKA, a proposal was made by Alan Fletcher, then Technical Editor of the old Aquarium magazine, that an "American Panchax Association" be formed. Although not a killy authority himself, he had observed the keen interest in these fishes and recognized the value of such an organi-zation to the hobby. The suggestion, however, elicited little tangible re-sponse from aquarists.

An early AKA meeting in the NY-NJ area. (L to R): Peter Hall, Albert Klee, Bruce Turner, Rosario LaCorte, Richard Blanc and John Gonzales.

In a sense, this is commonly the experience of many club bulletin editors who plead in print for articles. The response is generally nil and some editors find that only direct, face-to-face requests for specific material are fruitful. Fletcher, however, did approach two well- known killifish authorities but unfortunately, although these two hobbyists possessed the requisite technical killifish knowledge, they either did not have sufficient organizational ability or lacked the spirit to cope with organizational details, admittedly not always an exciting assignment.

Thus we come to another dictum in hobby organization: it is not always the "expert" who is the most effective organizer. Yet, regardless of organizing ability, the man with the reputation or the "title" is almost automatically chosen to lead. In any event, thus died the "American Panchax Association," stillborn.

In June of 1961, the author's telephone rang: "Hello! I'm Bob Criger. I'm interested in killifishes and wonder if we couldn't get together tonight for dinner?" With this telephone call, in effect the American Killifish Association was born. Bob, who was visiting his home offices of the Armco Steel Corporation in Middletown, Ohio (some 20 miles from where I lived), projected such bright enthusiasm over the phone that I accepted the invitation and drove to meet him.

Robert O. Criger turned out to be a tall, friendly, personable fellow, lately interested in killies. It turned out that his telephone call to me was triggered by a series of articles I had authored for the old Aquarium Journal (see Klee, Albert J,, "A Fresh Look at the Genus Aphyosemion," Aquar-ium Journal, August, September, and October 1960). This particular series was one in which I had invested a great deal of time and effort for at the time, little information was available with regard to these fishes. To-day, I look back at some of the inadequacies of that particular material with some misgiving. We have all learned much about killies since then!

In any event, Bob had read the series with interest and, knowing that I lived in the area, took a chance, located my telephone number and called me out of the proverbial "clear, blue sky." He was prepared with a list of killy topics for discussion that could have formed the basis for a good-sized book. These were tackled with enthusiasm for in those days, finding per-sons that were devoted to killies just wasn't easy!

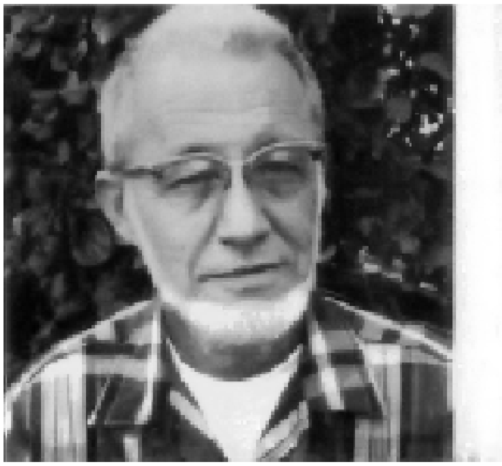
The conversation continued after dinner. We bemoaned the scarcity, not only of information about killies, but of the scarcity of the fishes themselves (today's killifish fanciers are really spoiled by the relatively easy access of these fishes!). Sometime after midnight, Bob thought out aloud: "Wouldn't it be great if we had some sort of club devoted solely to killies?" At first I was reluctant, knowing full well the work involved and that ventures of this sort usually wound up with but a few people carrying the main load, ultimately to fail because of general apathy. Further, the experience of the ill-fated "American Panchax Association" was not unknown to me. However, Bob was particularly interested in developing a professionally produced publication strictly for killies, and as he had had

In order for a committee of seven people dispersed about the country to operate without chaos, some system of corresponding had to be devised. Thus, the Charter Committee served as an experimental vehicle in which to work out the modus operandi that basically was to be used by future Boards of Trustees of the AKA. John Gonzales was instrumental in sug-gesting the technique that finally proved workable. (Briefly, the chairman of the group sends his letter to the others about the first of the month; by the middle of the month the others send their letters, with copies to all. The function of the chairman is to summarize comments, formalize mo-tions, assign motions a number and a place on the agenda, and to conduct and record the vote. Thus, regardless of where a participant resides, he shares involvement in policy-making equally with the others in the group. The chairman has no greater powers than his peers. He is an equal among co-equals, but traditionally acts to minimize discord and to expedite the flow of business. This approach serves to eliminate the one-man-show responsible for the many prior failures of national organizations.)

Many of the individual members of the Charter Committee, as might be expected, had particular interests in the structure of the Associa-tion. Charles Glut, for example, devoted much time to the concept of the "egg bank," a system whereby hobbyists would breed and maintain certain species of killifishes that might otherwise disappear from the hobby through neglect or lack of interest. (The internal debate over egg bank plans was, unfortunately, quite acrimonious.) Bruce Turner applied him-self mainly to the organization's acquisition of new species; George Maier cultivated crucial support from aquarists in the important Chicago area; I occupied myself with the preparation of the By-laws. All of us, however, actively discussed and debated all aspects of the new organization. During this time, Bob Criger, acting as publicity liaison officer, contacted all of the national aquarium magazines with a view towards publishing news of the proposed organization and keeping aquarists informed of the progress of the Charter Committee. All agreed to cooperate with the single exception of the Tropical Fish Hobbyist.

Robert Criger
AKA Chairman 1963

George Maier
AKA Chairman 1967



Robert Skirm
Early Chicago activist

Albert J. Klee
First AKA Chairman

laws stipulated that Trustees had to take at least a one-year "vacation" before they could run again for office). Only members from the United States or Canada could vote or hold trusteeship office (foreigners were considered, of course, but the problems of conducting business via the mails among counties militated against it).

Although the *Aquarium Journal, Tropicals,* and *Aquarium* magazine published many progress reports and announcements regarding the AKA none ever appeared in TFH.

Aside from the egg bank controversy, a friendlier disagreement arose, concerned with the naming of the new organization. The two main pro-posals advanced were: American Killifish Association, and American Pan-chax Association. The problem with "Panchax," however, was that it was based upon a scientific name long since abandoned by the profession, and applied originally only to a very few fishes. The major objection to "Killifish" was the implication that the animals "killed" other fishes. Such logic, however, when applied to fishes such as "tiger" barbs, tricolor "sharks," etc. quickly produced a reductio ad absurdum, and the Charter Committee voted overwhelmingly to select American Killifish Associa-tion as the official name.

The By-laws of the AKA contained several novel features. A seven- man Board of Trustees was devised as the policy-making force for the Association. For continuity, three were elected in odd-numbered years, four in even-numbered years, and all served two-year terms (an early amendment to the By-

An important clause read: "...no more than two Trustees of the seven shall reside in the same State in the case of the United States, or in the same Province in the case of Canada". With one clause then, the new organization avoided the old problem of regionalizing or concentrating power in any one particular area, an occurrence that killed many a prior national aquarium organization. Perhaps even more important was Article VII, "Mode of Operations," which stated: "Insofar as it is applicable, the business of the Association shall be carried out by written correspondence." Thus, in the AKA, anyone could run for the Board of Trustees and expect to participate equally with other Trustees if elected. It was no longer necessary to be rich, retired, or both to fulfill one's obligations as a Trustee. One did not have to travel, say, from Alabama to California to vote at a national convention or in vis-a-vis committee. A $.06 stamp and a little time was all that was required. The By-laws were adopted unanimously by the Charter Committee.

At the beginning of 1962, prospective members sent in $5.00 for their first year's dues, voted for seven Trustees and their choice of fish for the club emblem. Fourteen aquarists were nominated for Trustee based upon recommendations received by the Charter Committee from interested aquarists during the latter part of 1961). In order that hobbyists would know who they were voting for, bibliographic sketches were prepared by the candidates, edited into a standard format by the Charter Committee and distributed to the voters. This is a commendable practice, still followed by the AKA. The choice of fish for the Association's emblem, by the way, was closely decided between the lyretail and the blue gularis, with the latter receiving the nod.

The details of the results of these first elections and the subsequent development of the AKA are to be found in the pages of the Association's publications (particularly Killie Notes). As I do not want to unnecessarily burden the reader with such details, they will not be discussed here. Several general comments, however, might be helpful to other national aquarium organizations, extant or proposed. From the start, the AKA's publication program was a resounding success. Killie Notes (a professionally produced offset publication) came first. This was a mixture of topical club news and technical material. It was later decided to separate the two functions, and when the Association had sufficient funds, the publication was discontinued with two new ones taking its place: the AKA Newsletter and the Journal of The American Killifish Association (JAKA). Because the AKA depends so heavily upon the exchange of fishes and eggs among its members, a booklet entitled Killifish Exchanges was published soon afterwards. A host of other specialized publications appeared, the most important of which included a beginner's guide and the Killifish Index. In short, the publications activity of the AKA has been extraordinary — no other aquarium organization has ever matched it.

One of the most effective instruments for selling killifishes to the public and for recruiting new members proved to be the AKA's audio-vis-ual (slide/tape) program. Sight and sound told the Association's story and the story of killifishes. It was loaned free of charge to responsible hobby organizations.
One of the really vital activities of the AKA was, and still is, its free (to members) egg and fish listings in its monthly newsletter. This enabled fanciers all over the world to obtain, exchange, and even sell many differ-ent species of killies. From a historical standpoint, however, two species of killies in particular spurred special interest in the hobby in the late 1950's and early 1960's. Indeed, they were partly responsible for the founding of the AKA in that they created general interest in the family. These species were Aphyosemion filamentosum and Aphyosemion nigerianum, the former because it was a new, reasonably-sized and easily-bred "bottom

Roger Langton
JAKA Editor 1972-77

Rosario LaCorte
and John Gonzales

Hank Clemente
AKA Chairman 1873 & 1977

Theodore Dagleish
AKA Chairman 1965

spawner" (bottom spawners being relatively rare at the time); the latter also was an easily-bred fish but in addition, it was a brightly-colored and exciting new "top-spawner" introduction. The AKA should really erect a monument to these two species! Another species important to the early AKA was the blue gularis. It was a natural "salesman" for the AKA!

The AKA has come a long way since 1961, and it has since seen the participation of many hobbyists from all over the world. In a sense, the new killifish hobby is quite different from the old killifish hobby when I can remember paying $10 for a pair of Aphyosemion bivittatum in the days when $10 was equivalent to $20. The species available to hobbyists today would simply amaze the hobbyists of a generation ago! Those of us, however, who were privileged to assist in the formation of this great organization almost 10 years ago, will never forget those difficult but fascinating days of its birth; assuredly, we all treasure having had a chance to serve.

The Letter That Started It All...
June 22, 1961
Mr. Albert J. Klee 11374 Rose Lane
Springdale, Ohio .

Dear Al:
I have been doing a lot of thinking since seeing you last week...and a little work, too. You know more about these things than I do, but it's possible that what I am sending you might be the starting point of the International Killifish Society. Before I explain some of the things I thought about, I would like to say that I liked you very much and was very impressed with your frank and sincere manner. I feel that I am much the same as that...and like people who don't beat around the bush.

This I.K.S. idea has to work! I know it can be done if the informa-tion can be put out to the people. It is something that we have needed for a long time...and I hope you were sincere when you indicated that you would put all your efforts behind it.

I don't know whether or not you had a chance to write to Helen Simkatis...and it is quite possible that she has already told you that such a Society already exists — or that the possibilities of such a group are rather lukewarm. I hope no one is able to discourage you. I'd hate like hell to have to try to organize a thing like this on my own.

I hope you will look over the enclosed letter and questionnaire. Naturally they won't be absolutely correct, but as I said before, they might be a starting point for us. The letter is long — I know that — but it will take quite a bit of explaining, and I couldn't see any other way. We could send it out to anyone who inquired about the proposed Society through articles done in the various aquarium magazines. Of course, we would want to send it out immediately to those people we know are already avid killi-fish breeders. They'd form a nice nucleus from which to work...and I beleive (Sp?) each would want to join. (It's believe, isn't it?) It might not be such a good idea to send these things overseas written in English, but maybe you'll have a few ideas on this.

I am certainly not a rich man, but I would be willing to absorb some of the costs of getting this thing off the ground until we could get going. I can handle the printing in Kansas City...and will come up with enough letters, questionnaires, and return envelopes to take care of several hundred inquiries (or more, for that matter, if this thing should catch on). I will also handle the postage, and if we ever get any money, you can pay me back. I would also be willing to try my hand at getting out the publica-tion, though my technical knowledge might embarrass us if it were thoroughly checked each time. I could also handle the compilation of news letter material and get it printed and distributed. I do not want to handle the organization's funds — you could simply send me a check when I send you some bills.

There are, of course, some disadvantages in having the Society pub-lication based in Kansas City, Missouri rather than New York or some-place like that. But if it is necessary, I'll do most anything to give this group a chance to get started. I want nothing in return other than new friendships and new killifishes.

I am sure you will be able to improve on the letter and questionnaire, so go head and tear it apart if you like, and send me a copy of what you come up with. I don't see any reason for fooling around too long with the idea. Let's get the letter started — let's make the contacts with as many publications as possible and give them the necessary information about the proposed group — let's get our printing done — and let's start mailing out letters and questionnaires to those we already know in the hobby.
I make it sound easy, huh?

Don't let me down, boy. I've got a printer already lined up and we can even have a four-color cover on the magazine if we can come up with the transparencies. If you wish to consider the possibility of having out-side advertising in the magazine, let me know what should be done along these lines. As far as the legal matters involved in a venture of this kind, maybe I can shove that off on you. I would make a lousy lawyer.

By the way, did you write to Bruce? I did, and if you didn't, he will probably be shocked as hell when he gets my letter. It probably sounded like I've known him all his life. Is he touchy?

Bernard Halverson **Charles Glut**
Two of the "Founding Seven"

The Sjoestedti I got in Cleveland are beautiful and I am getting them accustomed to my tanks. I can't think of a reason in the world why the little boogers shouldn't spawn for me so I'm plowing ahead as if I didn't have good sense. Everyone I've talked to so far says they are nearly impossible to spawn. Maybe so. We'll see.

I'll be waiting breathlessly to hear from you, old friend, so get going with the old grey matter, and let's do something for the world of the killifishes.
Thanks again for driving up to Middletown to see me. The pleasure was definitely mine.
Your friend, Bob Criger

AKA Charter Members
(Those who joined prior to December 31, 1961)

Appendix Charter Members of the American Killifish Association (Charter Members are those who joined prior to December 31, 1961)

Adams, Dr. James N.
Allen, Franklin C.
Arnold, Herbert
Avaritt, Vernon K., Jr.
Bailey, Clyde Lee
Barron, William E.
Batson, Rev. Schuyler M.
Bezzek, Henry
Bishoff, Edward J.
Blackburn, Mrs. Dorothy G.
Blanc, A. Richard
Blomeley, Mrs. Helen J.
Boboricken, Stephen
Bode, George M.
Borchers, Curtis E.
Boxley, Adelbert
Britton, Leonard C.
Burns, Herald A.
Buttner, Richard
Chambers, Horace F.
Christiansen, Chris
Church, Edward A.
Collier, Glen
Collins, John P.
Cook, William Richard
Criger, Robert O.
Curran, William E.
Dahlin, George K., Jr.
Daly, Joseph J.
Daniel, James H.
Diehl, Robert F.
Dillard, Kenneth A.
Dramstad, A. Gordon
Dyer, William
Edwards, Gary
Emery, Dr. Frederic B.
Epstein, Dr. Eugene U.
Erichsen, Robert
Eyles, Philip
Fitzpatrick, Martin John
Foster, Gordon T.
Foster, Neal R.
Fox, Barry L.
Fuqua, Francis H., Jr.
Gardner, John E.
George, John E., Jr.
Glut, Charles F.
Gonzales, John L.
Greer, Lemuel Judson
Greig, Dr. Jack L.
Haas, Richard
Hallenbarter, Edwin
Halverson, Bernard K.
Hanisco, Edward
Hayter, Lyle Wm.
Hess, Chris
Hild, Norbert G.
Hill, Stanley W.
Hosford, Harry E.
Imshaug, Henry A.
Ingham, Ray W.
Irby, Bill C.
Jacobson, Ronald P.
Jagielski, Edwin
Jauer, Mervin B.
Johnson, Harold E.

Jurewicz, Michael
Kelly, James J.
Kemper, Bryan
Kenny, Thomas Eugene
King, Albert
Kitchen, T.L.
Klee, Albert J.
Knapple, G. Rex
Kowalski, Joseph P.
Krys, Gene A.
Kuhn, Grant L.
Kuhn, Mrs. Lorraine L.
Lally, Kenneth P.
Law, Richard W.
Ledecky, Emanuel
Locke, Gordon A.
Lorbiecki, Bunny
Lorentz, Lyle J.
Loria, Michael
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A Short Note on The Meaning of Panchax

Albert J. Klee, PhD

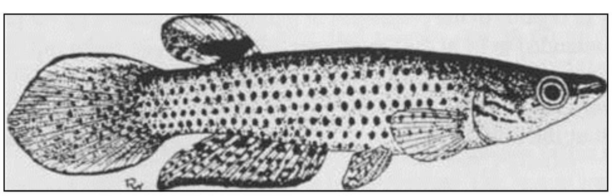
JAKA/KN Vol. 35, Issue 5, pp. 132-132, 2002

Panchax is a modification of the double-rooted Malay word, "pengcerah." With regard to cerah, since "c" in Malay is pronounced like "ch," a rough pronunciation is CHER'-RAH. (The "h" on the end of the word is a sibilant and should be aspirated when speaking but this is an added difficulty for non-Malay speakers and is of no importance here.) The word "cerah" simply means "bright."

Peng is a common Malayan prefix that indicates a noun (for example, "habis" means "depleted" or "all gone", so penghabisan means "last thing"), and is pronounced approximately as PANG.

Therefore, an approximate pronunciation for "pengcerah" is PANG-CHER'-RAH, and this was the word that was subsequently modified to Panchax. Another modification that readers may recognize is the Malay word for the scaly anteater, pangolin (from "peng" and "guling"), originally pronounced PANG-GO'-LIN. Since "guling" is the Malay verb for roll, it means "the one who rolls." referring to its habit of rolling into a ball when disturbed.

So, although literally meaning "the bright one," taking into consideration how it was used, Panchax can be translated to mean, "bright little fish," a very fitting name indeed.



Aplochieilus panchax **(aquarium import of 1964 from southern Thailand.) Drawing by R. H. Wildekamp**

March/April 2004
A Little Bit of AKA History

by Albert J. Klee, Ph.D., FAKA and Honorary AKA Life Member

JAKA Vol. 37, Issue 2, pp.70-72, 2004

During the middle of June 19611 received a telephone call from an avid killifish fancier who, after reading my series of articles on Aphyosemion in the Aquarium Journal the previous year, decided to track me down with the intent of setting up a personal meeting. The aquarist was Robert O. Criger, who at the time was a mid-level manager for Armco Steel in Kansas City, Missouri. He was slated to visit Armco's home office in Middletown the following week, which was about twenty miles from where I was living at the time. Little did I know that this was to be the beginning of the American Killifish Association. (The full story was told in the January, 1971 Killie Notes , Volume 4, Number 1, on pages 22 to 28, and it is currently available on the AKA's web site. The date of our meeting cited in both sources as "August of 1961" is in error, however; it should read, "June of 1961." We actually met on June 14th of that year.)

Recently I unearthed a letter from Bob that I received a week after we met, and I offer it for publication here for several reasons. First, it is the first ever, written documentation of the American Killifish Association. Secondly, it contains significant information of historical interest since, at the time Bob wrote the letter, he was arranging for the public relations campaign that would subsequently appear in the national aquarium magazines and also planning the first issue of Killie Notes.

Simultaneously I was contacting selected hobbyists, asking them to serve on the Charter Committee, and also writing the first draft of our Constitution and By-Laws. Finally I wanted to publish this letter because although

Bob and I are the co-founders of the AKA, he has never received the recognition he deserves. In fact, were it not for Bob Criger, I probably would not have been involved in the formation of any killifish association, and the AKA might never have appeared in its present form with its unparalleled status and influence in the aquarium hobby.

Readers will certainly appreciate Bob Criger's enthusiasm and his generosity and willingness to give both his time and financial resources to the fledgling American Killifish Association. For this, the Association owes him a large debt of gratitude.

June 22, 1961
Mr. Albert J. Klee 11374 Rose Lane Springdale, Ohio

Dear Al:

I have been doing a lot of thinking since seeing you last week...and a little work, too. You know more about these things than I do, but it's possible that what I am sending you might be the starting point of the International Killifish Society. Before I explain some of the things I thought about, I would like to say that I liked you very much and was very impressed with your frank and sincere manner. I feel that I am much the same as that...and like people who don't beat around the bush.

This I.K.S. idea has to work! I know it can be done if the information can be put out to the people. It is something that we have needed for a long time... and I hope you were sincere when you indicated that you would put all your efforts behind it.

I don't know whether or not you had a chance to write to Helen Simkatis... and it is quite possible that she has already told you that such a Society already exists — or that the possibilities of such a group are rather lukewarm. I hope no one is able to discourage you. I'd hate like hell to have to try to organize a thing like this on my own.

I hope you will look over the enclosed letter and questionnaire. Naturally they won't be absolutely correct, but as I said before, they might be a starting point for us. The letter is long — I know that — but it will take quite a bit of explaining, and I couldn't see any other way. We could send it out to anyone who inquired about the proposed Society through articles done in the various aquarium magazines. Of course, we would want to send it out immediately to those people we know are already avid killifish breeders. They'd form a nice nucleus from which to work...and I beleive (Sp?) each would want to join. (It's believe, isn't it?) It might not be such a good idea to send these things overseas written in English, but maybe you'll have a few ideas on this.

I am certainly not a rich man, but I would be willing to absorb some of the costs of getting this thing off the ground until we could get going. I can handle the printing in Kansas City...and will come up with enough letters, questionnaires, and return envelopes to take care of several hundred inquiries (or more, for that matter, if this thing should catch on). I will also handle the postage, and if we ever get any money, you can pay me back. I would also be willing to try my hand at getting out the publication, though my technical knowledge might embarrass us if it were thoroughly checked each time. I could also handle the compilation of news letter material and get it printed and distributed. I do not want to handle the organization's funds — you could simply send me a check when I send you some bills.

There are, of course, some disadvantages in having the Society publication based in Kansas City, Missouri rather than New York or some-place like that. But if it is necessary, I'll do most anything to give this group a chance to get started. I want nothing in return other than new friendships and new killifishes.

I am sure you will be able to improve on the letter and questionnaire, so go head and tear it apart if you like, and send me a copy of what you come up with. I don't see any reason for fooling around too long with the idea. Let's get the letter started — let's make the contacts with as many publications as possible and give them the necessary information about the proposed group — let's get our printing done — and let's start mailing out letters and questionnaires to those we already know in the hobby.

I make it sound easy, huh?

Don't let me down, boy. I've got a printer already lined up and we can even have a four-color cover on the magazine if we can come up with the transparencies. If you wish to consider the possibility of having out-side advertising in the magazine, let me know what should be done along these lines. As far as the legal matters involved in a venture of this kind, maybe I can shove that off on you. I would make a lousy lawyer.
By the way, did you write to Bruce? I did, and if you didn't, he will probably be shocked as hell when he gets my letter. It probably sounded like I've known him all his life. Is he touchy?

The Sjoestedti I got in Cleveland are beautiful and I am getting them accustomed to my tanks. I can't think of a reason in the world why the little boogers shouldn't spawn for me so I'm plowing ahead as if I didn't have good sense. Everyone I've talked to so far says they are nearly impossible to spawn. Maybe so. We'll see.

I'll be waiting breathlessly to hear from you, old friend, so get going with the old grey matter, and let's do something for the world of the killifishes.

Thanks again for driving up to Middletown to see me. The pleasure was definitely mine.

Your friend, Bob Criger

About the Author: Albert J. Klee is, along with Robert Criger, a co-founder of the American Killifish Association, and he is responsible for use of the term, "killifish," used throughout the aquarium world today. He was the first chairman of the AKA's Board of Trustees and its first Fellow. He was author of the original AKA by-laws, the first editor of the *Journal of the American Killifish Association* and the first editor of its Killifish Index. He has written hundreds of articles on aquarium fishes, some of which are indexed in the Zoological Record. He is perhaps best known throughout the aquarium world today for his authoritative work, "The Toy Fish, A History of the Aquarium Hobby in America, The First One-Hundred Years."

LIST OF ARTICLES IN THIS VOLUME, CHRONOLOGICALLY BY MAGAZINE

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KILLIE NOTES & JOURNAL OF THE AMERICAN KILLIFISH ASSDOCIATION

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1965

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1982

SOLUTION TO THE FIGHTING FISH PROBLEM

The Halfbeaks win. Three of the bettas are matched by three halfbeaks each; the fourth betta being attacked by four halfbeaks. In 10 minutes, it is bye-bye betta and the four halfbeaks now distribute themselves so that there are four, four, and five halfbeaks, respectively, against the three remaining bettas. After 8 minutes, another betta is vanquished. The other two bettas are only 4/5 done in, however.

The halfbeaks now distribute themselves in groups of six and seven, respectively. One betta is vanquished after 40/7 (the time required for seven halfbeaks to do the job on one betta) times 1/5 (the strength left in the betta) or 8/7 minutes. The remaining betta, however, has only 1/5 (the strength left to him before two halfbeaks joined the four to make it six against one) times 1/7 (1/7 because in the time it took seven halfbeaks to finish off their betta, six halfbeaks could only do 6/7 of the job, leaving 1/7 unfinished) of its strength left. This works out to 1/35 of its strength remaining.

Now all thirteen halfbeaks attack the remaining betta and they take but 1/35 times 40/13, or 8/91 minutes. The total time for the fight is 10 plus 8 plus 8/91 equals 19-3/13 minutes.