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Spawning *Cichlasoma spilurum*

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cover

A pair of **Cichlasoma spilurum**, female in the foreground. With some misgivings, because his experience with this cichlid species is limited mostly to intensive observation during the spawning process, Ruda Zukal has written a very interesting account (beginning on page 5) of a fish gaining in popularity almost daily. Photo by Ruda Zukal.

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Male Cichlasoma spilurum.

Spawning *Cichlasoma spilurum*

BY RUDA ZUKAL
Photos by the author

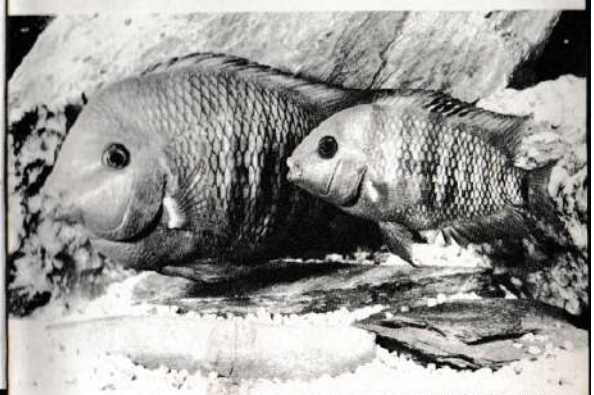
Female **Cichlasoma spilurum** guarding eggs.

It may seem a testimonial of poor judgment to write of a fish that I know little about, but this is the task I have set myself. Why do I write in such circumstances?—for the simple reason that I want to share my experiences with others who may have had even less opportunity to observe the species.

The coloring of *Cichlasoma spilurum* is very similar to that of the well-known *C. nigrofasciatum* except that the striping is not so pronounced. Young fishes may or may not show the mature patterning. Sex differentiation is not difficult; the males grow faster and become much larger and sturdier than females. Also, when mature fish are viewed from in front, the head of a female will be observed to describe a plain curve whereas that of a male displays a distinct bulge.

Aquarium specimens reach lengths between four and six inches and (in my experience at least) accept only live foods. The species is peaceful and may be kept in communities. They do not root in the bottom fill and disturb plants only during spawning activities. Because they are shy and become

The spawning female, her blunt ovipositor extruded, stands by expectantly as the male crowds into the spawning area to fertilize the string of eggs she has just laid.



The light area at the point of insertion of the pectoral fins is not an indicator of sex, as both males and females of the species are similarly marked.

especially nervous in a well-lighted environment, it is advisable to add floaters to the planting arrangement.

The literature available to me is rather limited and generally indicates that *Cichlasoma spilurum* spawns in caves. I disagree with this and have found that their activities are similar to those of most other members of the genus. Up to 500 eggs may be laid in a spawning; parental care may not be observed without some danger, since the parents, like members of other shy species, may be induced to eat their roe at the slightest disturbance. If undisturbed, the parents share the duties of guarding the eggs and the fry, for which a pit is prepared in the gravel when the young become free-swimming.

The pair shown here in spawning activities were received two-and-a-half years ago and have spawned several times each year. Most spawnings occurred in a community tank and on different substrata: the glass panes, a flower pot, or a rock, and behavior was exactly like that of *C. meeki*.

The male has taken up his position at the spawning site and waits for the female to move out of the way so that he can move in and fertilize the eggs.

The male has moved the female completely away from the rock and is fertilizing the eggs as she hovers nearby, waiting to deposit more.

The male begins to put himself into position to fertilize the eggs while the female completes depositing a group of eggs on the rock.

Whenever I transferred this pair to a special tank for planned photography, they declined to spawn, but on each occasion did so on the night of return to their customary tank. Eventually I ran out of patience and when I recently noticed the protruding ovipositor of the female and that the pair were excitedly swimming about in their large tank, I decided that the time for photographing a spawning was then or never.

Into a 15-gallon tank without plants, I placed rocks, roots, and a slab of slate set at an angle in such manner that I thought the fish could spawn nowhere else because of their size. Using strong filtration and tap water drawn the day before, I raised the temperature to 77° and placed the male into the tank. The female was introduced the following morning but was removed for the night, to be returned the next day, and this procedure was followed for three consecutive days.

During this period, the female had indicated an interest in a section of glass pane as a spawning site, so a slab of jagged rock was placed to bar approach and force her to choose the slate or a rock face in camera view. In the afternoon of the fourth day, an area of the slate was cleaned by the female; the courting play began, and soon thereafter I was able to begin taking the desired pictures.

BettaPhile

by *Gene A. Lucas, Ph.D.*

Fry Deaths

I may as well throw in my opinion on a common problem which has almost as many solutions as there are breeders. I refer to the loss of large numbers of fry soon after hatching or at some subsequent time before they are very old.

Many guesses have been made as to why this happens, some reasonable, some not so. One that is especially puzzling to me is that cool air, wafting over the water surface prior to and during the time the labyrinth is developing, will cause fry death.

The reason it puzzles me is that I have had so many experiences that seem to contradict the idea. These have caused me to totally disregard it, and I can see no ill effects.

For a number of years I bred fish in my basement. I have also used laboratory set-ups at two universities. I always spawn in uncovered tanks and I usually transfer fry at 2 to 3 weeks to larger uncovered tanks.

While I rarely have them, I *do* have fry losses. If leaving tanks uncovered were the reason, I would be having them always. If everything else was perfect I never would. Thus *something* causes it, but I don't believe "air" is it!

I think in all probability the prime problem is improper feeding. This can result in one of two things; (1) insufficient food, or (2) pollution of water by uneaten food, poisoning water for the fry.

Betta fry still in the nest.

For beginners or casual breeders the simplest feeding method is to start with newly hatched brine shrimp about the second day after the fry are free swimming. Many will not survive, but some should, and they can be fed nothing else all the way to maturity.

The real art comes in determining how much a given spawn needs. This will depend upon the number of fry and, as with any fish, I suggest feeding on the conservative side. With experience it will be possible to adjust the feeding frequencies and amounts upward to maximum efficiency.

This is a topic which needs considerable discussion, and I will pursue it further at another time. I hope prior to this I will hear from many of you regarding it.

With its very efficient teeth visible even through jaws almost completely closed, this female pike livebearer prowls menacingly around its tank, ever on the alert to snatch unwary prey. Photo by Gerhard Budich.

Belligerent *Belonesox*

By Lincoln Littrell

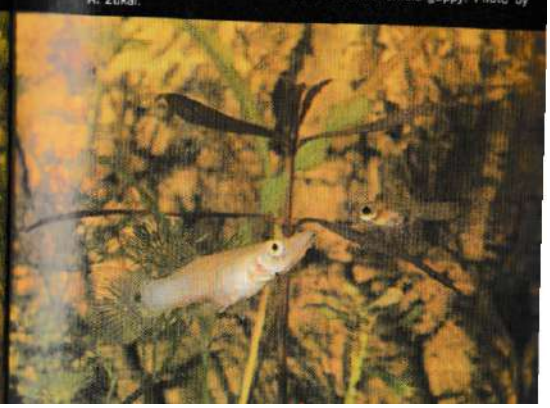
Largest of all livebearers, seldom kept by hobbyists, and a nasty customer is the pike livebearer, *Belonesox belizanus* Kner 1860. Adult females may attain up to eight inches in length, and males are variously reported as reaching lengths between four and three-quarters and six inches. The fish have torpedo-shaped bodies with dorsal and anal fins situated far back near the tail; the resemblance to a pike is noted at once.

The scientific name, pronounced *bell' on-ee" sox beil-i-zay' nus*, means gar-pike from Belize (a seaport and capital city of British Honduras). The

This female pike livebearer differs markedly in coloration from the female of the pair shown below; the color difference is normal, individuals of the same strain showing varying degrees of black pigmentation in the caudal and along the body. Photo by R. Zukal.

An adult male guppy has been seized by a male pike livebearer; once impaled on the sharp teeth, a victim has very little chance of escape. Photo by R. Zukal.

Adult male **B. belizanus** are immediately distinguishable from females because of their possession of a gonopodium, which is comparatively large in consideration of the total length of the fish. Photo by R. Zukal.



Here the same male **Belonesox**, belly bulging with the male guppy he has just swallowed, is about to seize an adult female guppy. Photo by R. Zukal.

only member of its genus, *B. belizanus* inhabits shallow standing or slow-flowing waters and occurs from southern Mexico to Nicaragua.

Fish of this size require a large aquarium, well-planted to provide areas of refuge. The addition of a tablespoonful of salt per gallon of water is conducive to well-being and usually necessary to promote spawning. Water of 72–86° is required, and temperature in the upper part of this range is preferred.

This surface-dwelling predator is entirely unsuitable for the community aquarium. It is always hungry; the elongated, wide-opening jaws armed with a double row of small, needle-sharp teeth are designed for grasping and holding prey, and smaller fishes seldom survive for long in waters inhabited by this voracious fish. An adult female has no difficulty ingesting fully-grown guppy and platy females.

Pike livebearers need rich, live foods, as adults generally spurn small prey, and may thus require to be fed such as worms, tadpoles, and dragonfly larvae to supplement a diet of fishes about the size of half-grown guppies. At times they may be induced to take prepared foods composed almost entirely of animal matter, especially if it is offered in pellet form tossed one at a time into the water so as to be mistaken for something alive descending toward the substrate.

Belonesox fry are inclined to school, but older fishes segregate; their innate pugnacity is then directed toward all other occupants of their territory, including individuals of their own species. Large females are especially vicious and refuse to tolerate males attempting courtship. Most copulations therefore occur only through sudden approach.

For breeding the species, a 10- or 15-gallon spawning tank should be prepared, providing floating plants for shading. Bushy plants in the end of the tank nearest the light source will further serve this purpose and provide cover in which the male can lurk awaiting an opportunity for impregnation of the female. An 85–86° temperature is ideal, and water depth of about seven inches is best. Old water with a tinge of salinity is essential to induce spawning.

Pregnancy lasts from four to six weeks and a large female will produce a litter of a hundred or more fry. The young may be three-fourths of an inch or longer when expelled. They are born hungry and can immediately feed upon daphnia and enchytraeids. If food is in abundance, growth is rapid, and guppy fry will soon attract them as dietary tidbits. On the other hand, the female parent may think her fry appear good enough to eat and proceed to gobble them up unless she is removed.

These fish are not attractive in appearance, and feeding them can be a problem unless an unending supply of half-grown guppies or other small fishes is available. But they are different and their predacious stalking of prey and other actions can well hold the interest of many hobbyists.

YOUR FISHES' HEALTH

Gyros

By
Roger
Lee Herman

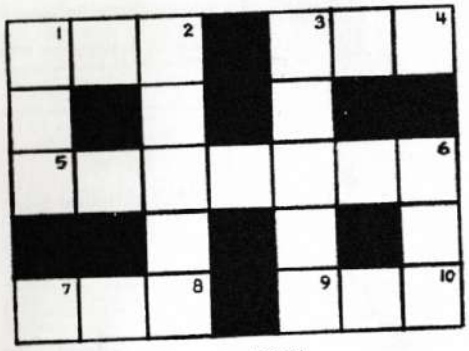
Many of the flatworms (phylum Platyhelminthes) are parasites. Monogenetic trematodes are important parasites of fish. These are commonly called "Gyros" from the name of the genus *Gyrodactylus*. The term monogenetic indicates that these animals have only one form of reproduction and do not require a second host, as do digenetic trematodes.

Most monogenetic trematodes lay eggs from which ciliated larvae hatch. A few species are ovoviviparous. That is, they retain the eggs in the body until they hatch. The young of these species appear as miniature adults. In both cases, the larvae swim about until they locate a fish. They then attach to the skin or gills and feed on the mucous and epithelial cells. Some species seem to remain in one spot after attaching, whereas others tend to move about. Some are found only on the gills and others only on the body surface under light infestations, but when a fish is heavily infested, the parasites may be found all over the body. Monogenetic trematodes occur in both freshwater and marine aquaria.

Fish infested with monogenetic trematodes may be seen "flashing." Mucous secretion may be increased to give a cloudy appearance to the skin similar to that seen with protozoan parasites such as *Costia*. If the worms are on the skin, small reddened areas may be seen. Irritation from heavy infestations will

DOUBLECROSS #1

ANSWERS ON PAGE 49



ACROSS
1-3. An angry fellow. a catfish
5. Vilified
7. A fish
9. A musical form
BACK
2. Can frustrate salmon
4. A witty remark
6. To come with and go without
8. Shelter
10. A fish

DOWN
1. Damage
2. First or last part of fish name
3. Worker who picks them up and puts them down
6. Add **fish** to name one
UP
5. Cichlid name
8. Existed
9. Burning again
10. Divinity

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Meet the hobbyist . . .

Melody M. McMullin

(Our hobbyist this month tells her own story, and we preface it only by mentioning that her aquascape photograph appeared as a photo contest winner in the October 1969 issue.)

Living in one room, especially one without private bath, presents problems to any fish-keeper. I didn't know what I was letting myself in for when I bought a large brandyglass-type bowl and stocked it with four colorful fishes: a red and green betta, a dark blue fish with black fins and tail (which I think was a platy though I have seen nothing like it illustrated), an angelfish, and a green catfish. In almost no time it was I and not the fishes "on the hook."

I have learned enough through my experiences and from reading TROPICAL FISH HOBBYIST to admonish anyone against expecting such a bowl to accommodate more than one or two small goldfish and that keeping tropicals in health requires more than food and a container of clean water. And I have spent many happy hours absorbed in maintaining my tanks and observing the fishes, as the brandybowl has long since been turned into a planter for succulents, with my fishes now occupying tanks (two of 10, one of 5, and seven of 2½-gallon size).

Melody McMullin and a few of her tanks.

When I bought my first aquarium I had nothing larger than a three-cup saucepan for filling it. To make matters worse, the tank was placed in one corner of my hotel room, while the basin was in the opposite corner. And after that first filling I used a separate container to age every drop of water added. I did many unnecessary things and lost several fishes until I learned through reading and from dealers' tips how to manage better.

Though there is a NO PETS ALLOWED sign by the manager's door, I have been keeping fish for some time and there has been no objection. Even if pets were permitted, not everyone wishes to be awakened at dawn or earlier by birdsong and have birdseed scattered about, to risk the damage that a cat's curiosity may lead to, or to be tied to daily dog-walkings; to such a person, fishes are the answer to the need for something alive and needing care. To one living alone and far from family and old friends, fishes can lead to such new friendships as I have formed among dealers and other fish fanciers.

By selling or trading offspring of my adult fishes I have added to the diversity of my fish communities without great expense. I look forward to the time when I shall have more room—to have more tanks. I recommend fishkeeping to everyone, especially to those who are tied to one room, and may your finny charges bring you as much relaxation and absorbing interest as mine have brought to me.

Photo by Laurence E. Perkins.

Shell Game

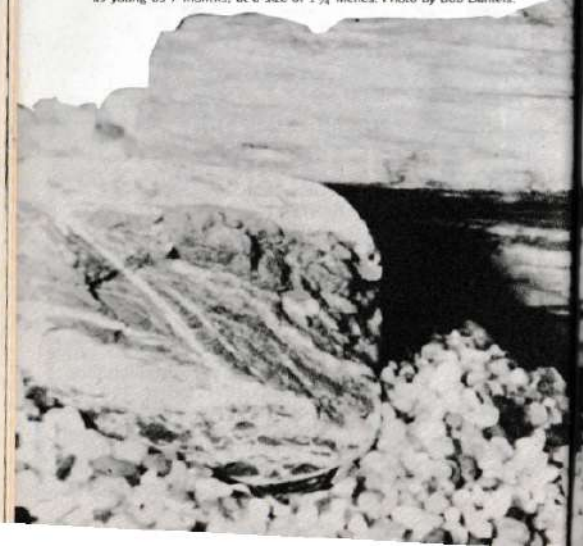
When seeking room for rearing young,
Bitter feelings often rise among the human kind.
When time is ripe for them to breed,
Bitterlings are faced with housing need and they must find
A mussel to be landlord to their spawn.
The female fish does neither beg nor fawn for tenancy;
She tickles with her breeding tube to charm
Against the closing shells of false alarm, then easily
Inserts the ovipositor all the way
To lay her eggs—and has no rent to pay.

LINCOLN LITTRELL

THE RUSTY CICHLID

by Kappy Sprenger

A pair of rusty cichlids, tentatively identified as a **Melanochromis** species; the male is at right. This pair of the author's rusty cichlids spawned within a few hours after this photograph was taken, after being returned to the aquarium in which they had been kept. The spawning produced 37 fry. Rusty cichlids have been recorded as having spawned as young as 7 months, at a size of 1¼ inches. Photo by Bob Daniels.



One of the Nyasa cichlids that I've had a lot of fun experimenting with in the last year or two is a reddish-brown fish popularly referred to as the rusty cichlid among cichlid specialists and others who've made a passing acquaintance with the species. Although the fish came by its popular name easily and naturally enough, the color of rust being a pretty good approximation of the color of the fish, its scientific name is a different story entirely. The fish has not yet been named definitively, although it almost certainly is a species of *Melanochromis*. For our purposes let's just call it the rusty cichlid.

Our *Melanochromis* is one of the Nyasa cichlids, small mouthbreeding fish originating in the African Rift Lakes. While most valleys were formed by water erosion or Ice Age movements, the Great Rift Valleys, in which lie the Rift Lakes, are immense troughs formed by earth movements, fractures, and the dropping of great sections of the earth's crust to lower levels. Extending thousands of miles across Africa, the Rift Valleys are studded with both active and inactive volcanoes, alkaline lakes, and hot springs. Because past volcanic action closed the channels through which fish might migrate, life in Lakes Nyasa and Tanganyika has been isolated, and now 98 and 99% (respectively) of the fish fauna in these lakes is endemic. Fish life can be found only in the upper 200 feet of water in Lake Tanganyika. Below these levels there may lie 4,000 feet of "dead" water that never circulates to the surface and is devoid of oxygen. Conditions in the depths of Lake Nyasa are similar. There are numerous other Rift Valley lakes, Albert, Victoria, and Rudolf being among the larger ones.

Rusty cichlids are lovely little rust-colored fish with the aggressive nature usually found in the Nyasa cichlids. Bright yellow dummy egg spots adorn the male's anal fin, and those of some females. The dorsal fin is outlined in orange, with a black band running directly below. On occasion, males have a glowing lavender tinge over their bodies.

In temperament a rusty cichlid does not quite equal the better known *Pseudotropheus* species for nastiness, but he certainly is not mild! Contrary to most methods of handling these fish, my tanks are crowded with them. Although there are many rocks and caves in the 22-gallon "hatchery tank," there are just too many fish for each to claim its own territory. As a result, there is a rather forced schooling pattern among most of them, with only a few males actually holding an area for any length of time. Lacking defined territories, the fish are less aggressive. Even those males that are able to claim and hold territory cause little trouble: if they leave their cave to bully others, someone else will move into it!

If the aquarist feels that too much bullying is occurring or that one fish in particular is getting the brunt of the aggressiveness, there are a number of alternatives that can be taken to insure the safety of the fish in danger. If a fish has definitely suffered injuries or if its belly is drawn in from lack of food (when badly frightened a fish may be unable to compete at feeding time regardless of the adequacy of food), it should be separated from the other Nyasa cichlids for conditioning. A partition might be placed in the community tank, or a small tank could be used for that fish alone. In a tank to itself, without gravel and with only one cave for hiding, a heavy diet of live foods can be provided 'round the clock, and it should not be long before the fish regains full strength and health. A fish removed for healing and conditioning should be treated like a female weakened by incubation, as discussed later. Regeneration of the Nyasa Cichlids is very fast, unless fungus interferes. Since many of the fungoid diseases in these fish are extremely persistent, the use of one tablespoon of non-iodized salt per gallon of water is very important as a preventive measure in isolation aquariums.

The removal of all rocks (or all but one) from a Nyasa community tank will alter the activities of the inhabitants. In conjunction with the removal of battered fish, this is probably the quickest and easiest way of quieting and conditioning the rambunctious mouthbreeders. For a day or two they will be frightened and shy without hiding places, but thereafter their boldness increases as aggressiveness decreases.

Although high alkalinity and hard water are preferable, these conditions are not absolutes. The fish can be spawned, raised, and kept healthy in water from 7.0 to 7.6 pH, with hardness levels ranging from 15 to above 50 DH. Up to one tablespoon salt per gallon is recommended. Temperatures in my tanks may reach lows of 70° and highs of 85°, since no heaters are in use. There may be a six- to eight-degree rise during the day, and an equal fall

during the night. All spawnings have occurred during the heat of the day, at anywhere from 76° to 80°. (The 85° reading was due to a summer heat wave, an extreme that should not be duplicated intentionally!) All these conditions will suffice in the incubating and conditioning tanks as well.

A rusty cichlid consumes relatively small amounts of vegetation, but either algae or fine-leaved plants (such as cabomba, anacharis or milfoil) should be available for them. The major portion of their diet has been adult brine shrimp, live tubifex worms, and slivered beef heart. The live tubifex worms are a special favorite and are most helpful in conditioning.

The sexual differences of rusty cichlids are not easily distinguished in young fish. Other distinctions lacking, it is usual to attempt identification of the sexes of the various Nyasa cichlids by the number, size, and clarity of the dummy egg spots found on the anal fin. In the case of *Melanochromis* however, a female may carry as many or more anal fin spots than a male, so it is still safest to follow the old rule of "Buy five or six and be sure" if spawnings are desired. Of the five males under my observation, three individuals carry two full and one partial dummy egg spots; the other two fish proudly erect their fins in courtship showing only one spot each! On the other hand, among the seven females the number varies from none to two. Dummy egg spots found on female rusty cichlids are not quite as large, nor as clearly defined, as those seen on males, but comparison is necessary in order to be certain of the difference. More reliable sexual characteristics in mature fish would be the heavier, "squarer" appearance of a male when compared to the more graceful, slender look of a female. Even when her belly is distended with roe the female appears smaller than the male in body. Like most other ready-to-spawn Nyasa cichlids, she merely looks plump and healthy, without the swollen, "stuffed" appearance of the non-mouthbrooding species. Under certain conditions male rusty cichlids especially may show an intense lavender tinge in the body. However, this lovely coloration is strongly subject to both mood and lighting, and cannot be sought as a reliable sex distinction. Although both sexes show a band of black running the entire length of the dorsal fin immediately below the orange border, in fish of similar size the male's black band is slightly broader and darker. Again, this coloring is dependent upon mood, and the general comfort and condition of the fish must be taken into consideration when hoping to ascertain sexes by color alone.

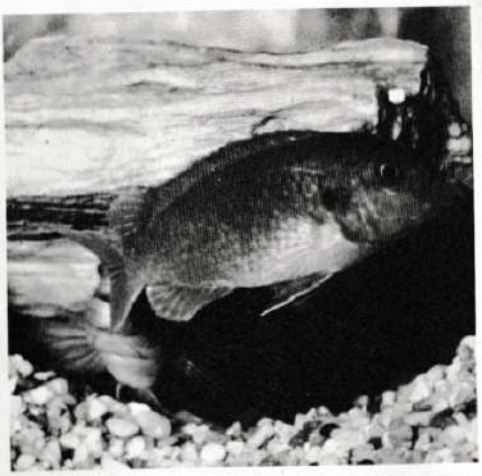
As of this writing, all my *Melanochromis* are still young and growing; the following comments may prove less accurate in regard to older fish; it certainly would not apply to fish of different ages. By the time of sexual maturity, any one of the five males in my tank was larger than any one of the seven females. The smallest male and largest female are both very close to three inches total length, at this time. The first female to spawn was a mere inch and one-half long! That spawning was unsuccessful, as there

were no males in her aquarium, and after three days her mouth was empty. Maximum length is probably four inches for males, slightly less for females.

To search for the ovipositor of a female Nyasa cichlid of any species is often a futile waste of time. With their darting movements and frequent shyness, even a large extended spawning tube might not be noticed. And the Nyasa females do not have large ovipositors, nor do they extend them to any degree, even during spawning. It is the actions of the fish plus heightened color that proclaims a spawning is about to occur

The male has selected (and probably fought for) his territory beforehand; the female may have her own territory, but is more likely to spend her time in any area not claimed by a male, bickering with other females, chasing and being chased, without actually defending one particular site. The females rather carefully avoid those areas held by males until spawning time approaches. If the fish have been in the tank for an extended period of time, the males may have done a considerable amount of digging (this also depends upon how much digging area a male has been able to claim). In some instances, very little digging will be done; in others, a vast mound of gravel may prevent viewing. A male will court females that gain his interest before they are ready to spawn. When the female is not ready, she will flee; if she flees she will usually be chased, although she may be chased anyway. As always in courting, the male attempts to catch his lady's eye with erected fins and body movements designed to show off his allure. The male rusty cichlid will shiver and twitch, swim in a tight circle or two, and shiver and twitch some more. At this point, the female may head for hiding as fast as she can! But if she doesn't flee, if she does remain in full sight of the male (although not yet responding to him, as she barely deigns to notice him at all), things are well on the way to a spawning. These actions may go on for days before the next stage occurs: the female eventually twitches and quivers for the male. The pair then take turns quivering before each other, the head of one pointed towards the anal area of the other, stimulated (at least in the case of the female) by the dummy egg spots on the anal fin of the other. As their excitement intensifies they move closer together, slowly moving in a circle as they quiver together, nudging each other's flanks and nibbling at the dummy egg spots. (This courting position is similar to that of two fish fighting; however, when they fight the circles are larger, no quivering occurs, and they swim fast in attempts to bite each other.)

Shortly thereafter, the female will begin laying her eggs, a few at a time, on either the gravel, tank bottom, or a rock. After the eggs are fertilized she will pick them up carefully before laying another few. The male may make occasional scouting trips to assure himself that no intruders have dared enter his territory, and as he goes he may nip or chase any fish within reach, as a warning, before returning to the female. She rarely leaves the spawning site—unless she is spawning with more than one male at a time! If that is the



The female rusty cichlid, less blocky in shape than the male; although this female shows no eggs spots, others do, so the presence or absence of such spots is not a reliable indicator of sex. Photo by Bob Daniels.

case, she will visit one male, court briefly, lay her eggs, pick them up after fertilization, and either lay another few or move on to the next male's site to spawn again. When this happens, the males can only be described as being fit to be tied! They become frantic, not daring to leave their territories at all; they may dig furiously for a few moments, then dash to the very boundary of their territory, patrolling back and forth until they see the female again heading in their direction. The male to whom she is returning dashes ahead of her to the spawning site, immediately begins courting and nudging, and welcomes her in every way possible for a fish. The female, although she had earlier responded to such actions, seems to have an attitude of "Haven't we gone through this before?", and settles right down to spawn.

She will, of course, leave him again very soon to continue on her rounds, with each temporarily abandoned male as frustrated and frantic as he had been moments earlier.

Once all the eggs have been expelled the female will seek seclusion. Full as her mouth may be, she is anything but helpless: her tiny teeth are set well in the front of her lips, usually protruding and in full sight. Regardless of her full-mouth capabilities (or lack of them) for biting, she can ram with formidable results! It is best to remove her, of course, for her own safety, and that of her tankmates, and the survival of the fry.

Two females may spawn at the same time, too. Because there is so little preparation of the spawning site by paired fish, the territoriality does not increase at this time as it does in cichlid tanks where strong pairs are formed. The Nyasa tank is apt to be in a state of uproar continuously—spawning pairs don't make it much worse! It is not unusual for a pair to abandon one spawning site for another in the last moments of pre-spawning; often the male's chosen territory is just not quite large enough to encompass the pattern of movements in actual spawning, or possibly another pair has already started spawning in the vicinity, and it is too close for comfort.

When spawning is completed, the egg-carrying female's lower jaw and throat will protrude, and the lower half of her gill covers may also bulge outwards, giving her a slight Bugs Bunny (without the ears) look from the front. Some chewing motions occur when she moves the eggs around to clean and settle them. The tank into which the female will be placed need not be large: anything from a 3-gallon to a 10-gallon size will suffice. Although the fry will eventually need more room, it is easier to feed them adequately without overfeeding when fry and food are more or less concentrated in one area. At least one good hiding place should be provided for the shy female, and since rusty cichlids do very little digging while incubating (in contrast to certain *Pseudotropheus* species), plants can be used

without their being torn out and ruined. Water conditions in the incubating tank should approximate those of the spawning tank, with all adjustments made and checked before addition of the fish.

The length of time for incubation depends somewhat upon water temperatures and somewhat on the individual females, as there is great variance of releasing procedures. During the days of incubation the female divides her time between her cave or hiding place and an area of clear, open water slightly above and in front of the cave entrance. Females may or may not accept food during incubation. Non-living foods were invariably refused in all instances I observed. All females showed interest in live brine shrimp, to one degree or another. To catch and eat their food, with a mouthful of eggs, they must approach the wiggling shrimp slowly, suck it in, and somehow sort eggs (or squirming babies!) from the wiggling shrimp. It is a rather time-consuming process, and the fish usually return to their caves while conducting the last stage. Since the species generally prefers live tubifex worms to any other foods, incubating females might be expected to react in the same fashion. I have not tried it, however, because the incubating tanks do contain gravel, and rarely does a female respond to the addition of food to her tank with a boldness that would permit capture of a worm before it entered the gravel.

The releasing of the fry is an intriguing process, varying from fish to fish, and all too often overlooked by the aquarist. In most instances, there is no actual "time of release" *per se*: for hours, and usually for days, the female has been releasing and retrieving fry, always carrying some in her mouth so that a quick glance at her might bring an impatient "Not Yet!", while the fry that have been released will not be seen unless one is either very lucky or very patient. However, there is a sign that release has begun, for which one may watch: the female becomes restless, investigates corners and crevices, and seems to be fretting over every plant and pile of mulm. Constantly on the move (unless startled), there is nothing in the aquarium that she ignores, and if live brine shrimp are present, they will receive special attention. The resting posture that has by now become familiar to the aquarist is gone, and in its place there seems to be an inability to remain still for even a moment.

At temperatures in the high 70's, the fry will begin making their appearance between the 17th and the 21st day. I had an excellent opportunity to observe incubation and releasing when two females spawned at the same time in the same tank and were then placed in the same aquarium, partitioned by material through which water could pass. In other words, the environmental factors were the same, and even the rocks and plants on either side of the partition were similar in size and arrangement. However, the females were not the same! One spent nearly four days in the complicated

releasing process, while the other spent less than two hours! The one that spent two hours did pick up her fry on the 21st night, while the other did not. Aside from that night, the fry from both females were all released without again being retrieved by the 21st day. Unlike some Nyasa cichlids, rusty cichlid females do not seem to have distinctive color patterns as they release their fry.

The term "spitting out" of fry is highly inaccurate when applied to Nyasa cichlids. When being released, the fry seem to "dribble out" of their mother's mouth, limp and motionless, head-first, tail-first, every which way. They slowly drop to the rock or gravel over which they were released, many remaining motionless even when they reach a surface. (The distance that they drop is small—less than an inch from mouth to rock or gravel.) A few fry will wiggle rather helplessly, and a few will swim away. Most will do nothing at all if it is an "early release" (i.e. days from when all fry will be on their own in their mother's eyes). Within seconds after she has released the fry, the female will pick up those that have not moved away. Any number between one and twelve may be released at a time, and the female may release another batch within minutes of picking up the previous ones. Or it may be hours between releases. There are a few specific release sites, and only rarely are any fry released in any other places. The sites are approximately two inches in diameter, sometimes located by a rock, a plant or a shallow pit in the gravel. As yet I've never seen fry released inside the female's cave.

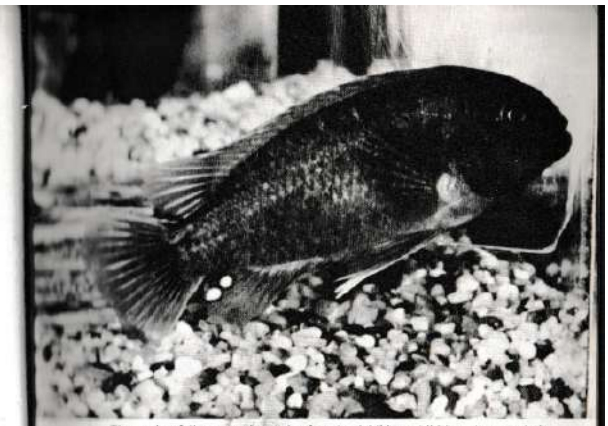
Some fry will "swarm" at the mother's mouth as soon as they are released, and these will be allowed entry, at first. The closer it is to the day of complete and final release, the less apt will be the female to allow the "swarmers" back into her mouth, although she will unhesitatingly retrieve a fry that is weakly swimming or resting in the sand. In this manner, those fry that are strong enough to seek refuge in plants and caves (those that are better prepared to fend for themselves in possibly hostile waters), are allowed to go their way. And they do! At the slightest disturbance they will either "freeze" or dart to less open areas, and the female reinforces their avoidance of moving objects by chasing them. All the poking around in corners that has been mentioned as signifying release is directed towards finding the fry. When found, they are chased. Or if they weakly refuse to be chased, they are picked up for further incubation. The female does not, however, try to catch those fry that flee—she just chases them. She can pick them up any time she pleases! Her approach, when fry are to be picked up for the night, is entirely different: moving slowly, with fins relaxed and close to her body, she calmly approaches them from the side, nuzzling them first, and then gently sucking them into her mouth. If the releasing and retrieving has gone on for days, female and fry will settle down to a less hectic existence; there will be less chasing, and the fry will neither avoid nor seek their mother.

Fry that are released at the last moment, as in the two-hour release mentioned earlier, usually do not achieve that quiet "*status quo*" relationship with their mother before she is removed for reconditioning.

The number of fry to be expected from young females of two to three inches of length is between a dozen and thirty. In older fish, there may be more.

Feeding of these large babies (they are about ¾ of an inch long) is simple. Live baby brine shrimp is probably the best food, but they will thrive on a diet of frozen baby brine shrimp, daphnia, and the high quality flake foods. Within a couple of weeks, if feeding has been adequate (at least three feedings a day, unless the baby brine shrimp are alive and fed in quantities sufficient to last for many hours), the young rusty cichlids will be ready for frozen or live adult brine shrimp. At a month of age (swimming age!) they should be an inch long, if not more.

Reconditioning of a female is very important. She should be removed from the fry as soon as it is clear that her days of care are ended. As a mother, her job is intense, and once finished, her care stops abruptly. When she has stopped carrying fry around in her mouth, she will do no more for them; there is no schooling, no herding, no protecting. She will attack other fish—just as she always would—and scatter the fry without later making any attempt to gather them back to her. Eventually she will probably eat some of them. So she should be removed from the fry—but not returned to the Nyasa community tank.



The male of the spawning pair of rusty cichlids, exhibiting characteristic dummy egg spots. Photo by Bob Daniels.

In her weakened condition—and she is weak whether or not she has eaten during incubation—she would be in no state to face the other fish. She just won't be up to that. The quickest method of bringing a fish back to strength is to keep live foods before it all the time (as well as providing proper water conditions). Tubifex worms are excellent, but if they are to be available to her 'round the clock, there cannot be gravel in the conditioning aquarium. A flower pot with a hole knocked out of the rim, upside-down, provides adequate hiding space without creating inaccessible corners in which the worms can gather. Live brine shrimp and mosquito larvae may also be offered, but tubifex seems to do the best job.

In many instances the female will be plump and strong within two weeks after releasing her fry. Longer isolation should not be necessary if food has been plentiful and good. But before returning her to the Nyasa community tank, certain steps should be taken: thoroughly disrupt the community tank! By removing all rocks and siphoning out a quarter of the water before putting her back, the other fish will not even notice the addition of a newcomer. (When a fish is added to an established aquarium, it is known as an outsider at once and must fight for its place in the pecking order—and for its life, with the more aggressive fishes.) Once the Nyasas are thoroughly

disrupted, introduce the female (or new fish), replace the rocks in different positions and formations, replace the siphoned water with fresh, and observe. The fish will be so busy re-establishing territories, deciding what and whom is best where, that they will not turn on the newcomer, and she will have as much chance as you can give her to safely make her way into a place in the tank.

Although none of the Rift Lake cichlids known and observed seem to have quite the personality of a friendly oscar, or the fascinating habits of a convict cichlid, their beauty in color is unmatched, and they are a real challenge for the aquarist who likes fish that keep him thinking!

"... AND NOW, GANG, FOR MY FINALE, I WILL ATTEMPT A TWO-AND-A-HALF SOMERSAULT OVER AND AROUND THE LEFT SIDE OF THE NET."

salts FROM THE seven seas

BY FREDRIC M. SCHWARTZ

Q. I have a 78-gallon (16x18x50) freshwater aquarium that I wish to change over to a marine aquarium. My aquarium is entirely made of glass held together by Dow Corning Aquarium Sealer. Will salt water attack the rubber sealer? Also, how many fish should I keep in this size tank and of what type?

A. Salt water will not attack the sealer. Your tank should be excellent for marine fishes, but I suggest that you start with a smaller aquarium. The number of fish depends on size and type. Large fish need more space, as do the more active species. A good book on marine fish will help you decide as to type of fish you might be interested in. I recommend Dr. Axelrod's new Exotic Marine Fishes, *as it is the most complete book on the market. By reading this book you will better be able to decide on the type of fish you are interested in. Start out with the easier and less expensive fish and add to your collection as you gain experience and confidence. Since you are a beginner in the marine hobby, I cannot stress too much the importance of starting out small. Too many people have become disenchanted with the hobby because they went overboard and spent a lot of time and money only to be rewarded for their efforts with a very expensive tank full of dead fish.*

Q. In my freshwater set-up I use an undergravel filter with very heavy aeration. After the first few months I tried to keep the pH and hardness just right. I lost some nice fish, discontinued this and have had no trouble by just taking the water from my tap (hardness 4 and pH neutral). Would the same be all right for a marine set-up, or is the hardness and pH that important?

Lynn Adams
Longview, Washington

A. I would add a large outside filter to your set-up. You need not worry about hardness in a marine aquarium. If you plan to use a synthetic mix your water may pose a pH problem. However, most marine mixes are buffered and should adjust close to the desired pH. You will need to get a pH kit that is for SALT WATER ONLY, as freshwater pH kits will not work. Your pH should be about 8.3 to 8.6. You may have to add some chemicals to adjust. There are usually directions for this procedure along with the directions for the mix.

Q. We are in the process of setting up a 50 gallon marine tank. As this is our first attempt, we want to take all the necessary precautions. Our dealer tells us that it is necessary to age the water for about four weeks, but I have read that this is not as important as with fresh water. Could you please discuss this, as we are becoming impatient with our empty tank.

I have also read that green algae can be encouraged. I have only seen brown algae in my dealer's tanks and assume this is due to limited lighting. How can we grow green algae, and will this brown mess "green up" if exposure to light is increased?

We are having quite a bit of trouble deciding whether to keep invertebrates or fish. Is there any combination that would be reasonably successful, to enable us to keep a few invertebrates? We have become particularly interested in urchins, coral shrimp and fan worms.

Lastly, is pH a vital element? I have kept fresh-water tanks for several years and never worried about it. Is this a greater problem with marine fish?

Mrs. Robin C. Fritz
Davison, Michigan

A. If you are using a synthetic salt water formula it is not necessary to age the water more than one or two days. After the water has been

added to your tank it should be allowed to set for one or two days. Filtration must be maintained during this period. If the tank is clear at the end of this period it is ready for use. If it is not clear, allow it to sit until it is. If you are planning to use natural sea water, see this column in March's issue.

The brown algae might turn green if you increase the light but there is of course no certainty that it will. It seems that the best light with which to grow algae is incandescent light. If you are using fluorescent bulbs you will have to use a higher wattage than is normally recommended for lighting a fish tank. I personally favor growing algae in a tank for many reasons which are too numerous to go into at the present time. I grow algae on all but the front glass of my tanks and encourage you to try it. Some people consider it messy looking, but I think it is more natural looking . . . and the fish like to nibble at it.

With reference to keeping invertebrates in your tank, I say do it, by all means. I keep hermit crabs (½ to 1 inch) in all my tanks. They

SHOW DATES

Ventura County Fish hobbyists will sponsor the fish exhibition and competition to be held in conjunction with the Ventura County Fair, October 7 through 11, at Seaside Park in Ventura, California.


Coral shrimp

are interesting creatures and are good scavengers. I also keep spiny urchins, brittle stars, small starfish, arrow crabs and coral shrimp in my tanks with fish. If they are small in size they will not bother your fish. The only problem you might have is the fact that the fish may eat your invertebrates, especially the shrimp and the crabs. Fan worms are nice but may end up as a meal for your fish. They are better kept in a tank by themselves.

pH is at least as important in a marine tank as it is in a fresh water aquarium. It must be kept at a fairly constant value. Variations of plus or minus 0.2 must be avoided. Although pH value will vary somewhat from species to species, it shouldn't fluctuate much from the 8.5 area. A special kit for measuring pH must be utilized, as the kits used for fresh water will not work for salt water.

DEAR DR. AXELROD:

From THOMAS TERRANELLA, 23 Richmond Street, Carbondale, Pennsylvania 18407

For 13 years I have been a hobbyist. Like most people, I branched out until I found a subject matter that interested me. My interest lies in breeding fish to grow to a maximum size and quality. I think I have stumbled across something that achieves many things.

First let me say that I have employed all of *your* methods and have tried to duplicate my subject's natural habitat. After doing this, my next effort was to introduce different foods: some obtained good results, but none like I have experienced in the last three years.

It all started with a pair of fancy guppies. After much fuss with brine shrimp, I decided to try and duplicate what brine shrimp is made of. I found that brine shrimp are very good food because they contain a lot of protein, so I went out and purchased a bottle of high protein tablets, 250 mg., and melted the tablets in a glass of water, feeding the guppies daily upon this solution. The fish seemed to thrive on this, though their color was slightly affected. I started with a half-black pair with red tails; the babies were all solid red, but they had well balanced bodies, long dorsals and beautiful delta tails after about three months.

Subsequent spawnings held true. A friend of mine who breeds zebras fed his fish my same high protein formula and in two and one half months they reached an average of 4 inches in length. They didn't spawn, but I didn't have time to devote to them because I was interested in trying another egglayer.

I tried the same thing with bettas; again, they grew very well.

After trying many other fish and still using the high protein tablets,

STARTR-WATR

If you obtain fresh tapwater at 75° and add 8 drops of STARTR-WATR per gallon to this fresh tapwater, you can almost immediately place your fishes into the aquarium containing this treated tapwater. STARTR-WATR contains sodium thiosulfate to remove the chlorine; methylene blue to keep the bacteria and fungus count down, and potassium permanganate to prevent water clouding.

There is no more effective chemical for conditioning tapwater for the new aquarium. STARTR-WATR prevents clouding and sterilizes the new aquarium water at the same time. Available in 1 ounce and 4 ounce dropper bottles.

From Miracle, the people with know-how.

MIRACLE PET PRODUCTS, INC., JERSEY CITY, N. J. 07303

I find that my fish grow very, very fast and I think this is a worthwhile food supplement to your freeze-dried foods. I suggest that you make my protein tablets available for fish food.

All of our Miracle freeze-dried foods are high protein. I am sure that your fish cannot live on high protein tablets dissolved in water. Your tank is probably a foul-smelling mess, unless you have in it something which is eating this nutrient solution you are putting into the tank. Perhaps you have worms or crustaceans growing in your tank and don't know it. Anyway, I tried what you did, and I found that the tank was just a brew which almost started to bubble!

I think you are better off sticking with the regular fish foods.

From **PHILLIP HILGERT, 4223 Poppleton, Omaha, Nebraska 68105**

While raising bettas, I came across the age-old problem of keeping the young and old male bettas separate. The main difficulty was that I could not keep the temperature up in all jars at the same time, as I kept my bettas in jars. And I also had to spend a terrific amount of time cleaning separate containers. I feel that I have a reasonable solution to this problem. It would consist of light clear plastic jars which would be perforated to allow easy circulation of the water. The jars would be about 4 inches deep with a radius of about 2 inches. These would fit into a shallow aquarium of 5 inches

in depth and a width and length of two feet. The aquarium could be equipped with a heater and airstone for even distribution of water by moving it through the holes in the containers. As for cleaning, the bottom of the jars would be perforated so that uneaten food and waste materials would fall to the bottom of the aquarium to be disposed of by snails or filters. If cleaning were needed, it could be done by vacuuming out the settled debris.

Miracle makes a betta aquarium that has glass partitions. The advantage of the glass partitions is that you can remove them to let a male and a female get to each other for spawning, or you can add additional partitions and keep as many bettas as you like. These are almost invisible to the naked eye, and when you need an aquarium without the partitions, you simply remove them and have a regular aquarium.

Your idea is good, however, and people with just a few bettas might be able to buy plastic jars and punch holes in them with heated pins.

ANSWERS

DOUBLECROSS #1

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R	E	V	I	L	E	D
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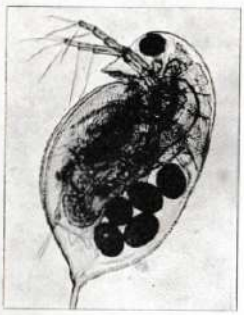
From **GREGORY G. SAFRANSKI, Box 3065, West Lafayette, Indiana 47906**

I noticed your advertisement in T.H.F. magazine asking for ideas of new products which could be used by hobbyists. For some time I have been doing research with daphnia in order to find a method of stimulating their production of ephippial eggs. I found that it is only necessary to chill or crowd a culture of daphnia in order to produce ephippial eggs. These eggs may be collected and stored. In order to hatch them, they should be frozen to simulate winter; eight thaws and freezes give the maximum yield.

As you know, live daphnia is an excellent food for tropical fish, but until now it has been hard to obtain by the average hobbyist. With the use of ephippial eggs, however, a hobbyist could have a constant supply of live daphnia all year long.

I believe daphnia eggs would sell very well and would like to introduce this product to the market myself, but due to lack of funds and experience in sales, I am unable to do so. With your knowledge and resources, however, I believe you could make this a very profitable and practical product.

Miracle would be very much interested in marketing daphnia eggs. But the market would be much bigger than the supply, and we could not even think of marketing the eggs unless we could be sure of getting at least 500 or 1000 gallons of them.



Female **Daphnia**, with eggs visible in egg sacs. Knaack photo.

If you are able to produce this quantity of eggs, we would be happy to discuss the matter with you.

Please send us a sample of the eggs so we can test them, as I think you have a marvelous idea and one which will be very valuable to hobbyists.

From **MARY GALVIN, 133-20th Avenue, Hopkins, Minnesota 55343**

There are three things that I would like to bring to your attention:

1. Millions of dollars are spent on water test kits, but what good is knowing what is wrong with your water when there is nothing to correct it with? Most of the stuff you put into an aquarium only makes the water worse and may even kill the fish. Why not a small pail-type water softener that will remove the minerals from hard water? We have well water with lots of minerals. We do not want a water softener connected to our water system, and I need a very small water softener that I can pour water into and remove the minerals.

2. I want to raise egglayers. They hatch beautifully but when I begin to feed them, I can't find a filter that works. I keep the babies in a bare tank and would like a filter that would not suck the babies up. I hear there is a filter with a plastic sponge in it, but no dealer around here has it. How about a filter that really works in bare tanks for tiny egglayer babies? I have lost several hundred angels and gourami babies because of this.

3. Where can a person get peat moss? German or English. All the books talk about it, but it is not available around here at either pet shops or greenhouses. Couldn't this be packaged and sold?

1. Miracle makes a water softener which is part of the filter. Just put the water softener into your aquarium and it will soften the water. The softener can even be recharged with salt water.

2. Miracle makes a baby-saver aerator filter which is perfect for a tank that has nothing in it. It has a special chamber that allows the babies to stay inside the filter if another fish is chasing them. They are absolutely guaranteed not to kill baby fish or suck them into the filter.

SOFT-HARDNESS TEST KIT

3. I think you are right. Somebody should market the German peat moss, and I am going to suggest to our company that we do it soon.

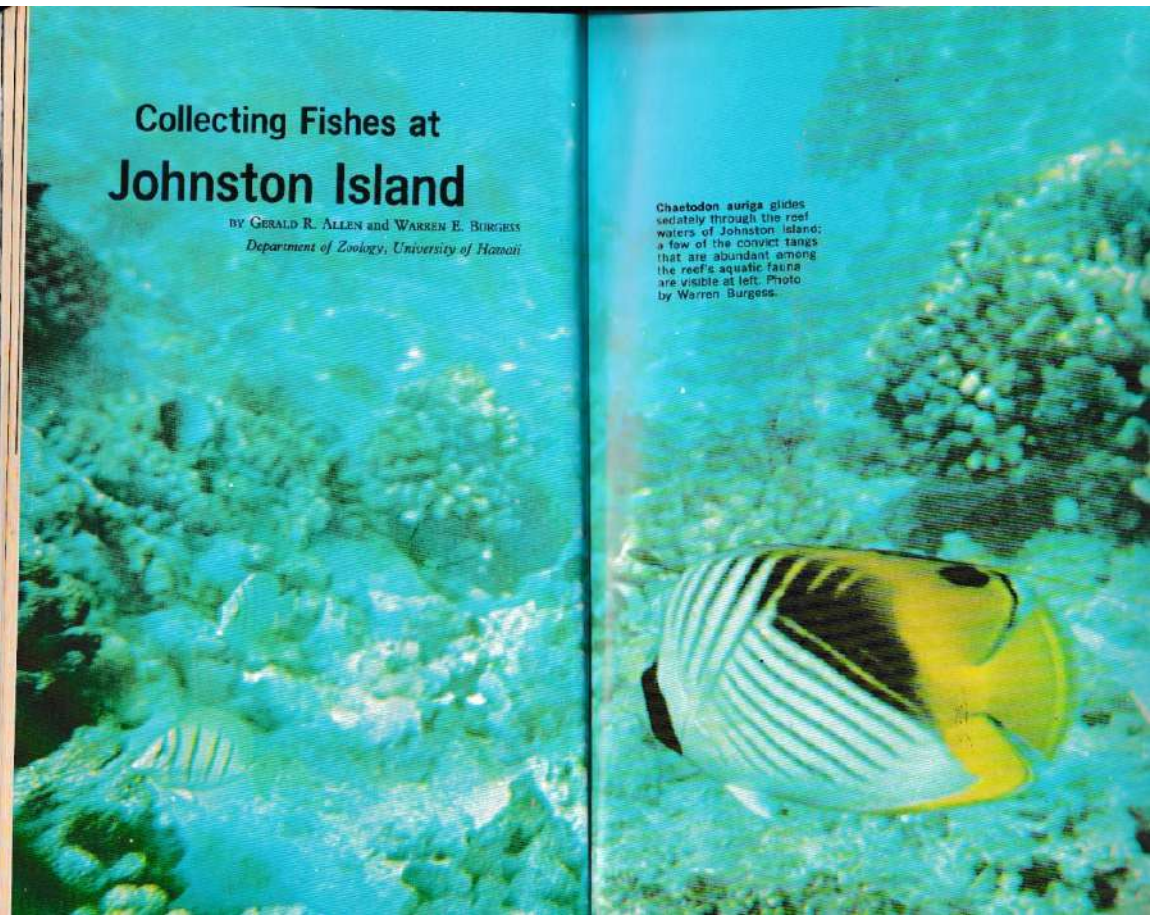
From **ROY SOKOLSKI, 2906 Lawrence Drive, Wantagh, New York 11794**

Too often I find that I need a long piece of airline tubing but have only two short pieces. In need of a way to join these two pieces, I have made my own joiners by cutting small pieces of plastic air tubes from old filter stems, etc. However, I feel that it would benefit all aquarists if you made small airline tubing joiners of plastic with a smaller diameter than that of the tubing itself. In this way, we could save on airline tubing.

We make a 3-way plastic valve that is very cheap. Not only can it be used to join two pieces of plastic together, simply by turning off the valve itself, but it also can serve as a 3-way valve. In this way, for a few pennies, you have your connector as well as a valve when you need it.

Collecting Fishes at Johnston Island

BY GERALD R. ALLEN and WARREN E. BURGESS
Department of Zoology, University of Hawaii



Chaetodon auriga glides sedately through the reef waters of Johnston Island; a few of the convict tangs that are abundant among the reef's aquatic fauna are visible at left. Photo by Warren Burgess.

The DC-7 climbed smoothly to its cruising altitude and made its final turn southwest towards Johnston Island, a small speck some 600 miles from Honolulu. We had four hours' flight time to go over plans for our two-week stay on the island.

Johnston Island is of special interest to marine zoologists because of its strategic situation between the Hawaiian Islands to the north and the great tropical Pacific region to the south. An analysis of the Johnston fishes provides vital information concerning the origins of the Hawaiian fauna. With these facts in mind, we eagerly accepted an invitation to participate in January, 1968, on a trip to the island to collect large moray eels. The eels were to be trapped or speared, then frozen and shipped to the Hawaii Institute of Marine Biology. At that time the Marine Toxins Program at the Institute was conducting experiments in an effort to determine the cause of fish poisoning, or ciguatera, as it is often called. Previous studies had indicated that about 80% of the large moray eels, *Gymnothorax javanicus*, from Johnston Island were toxic.

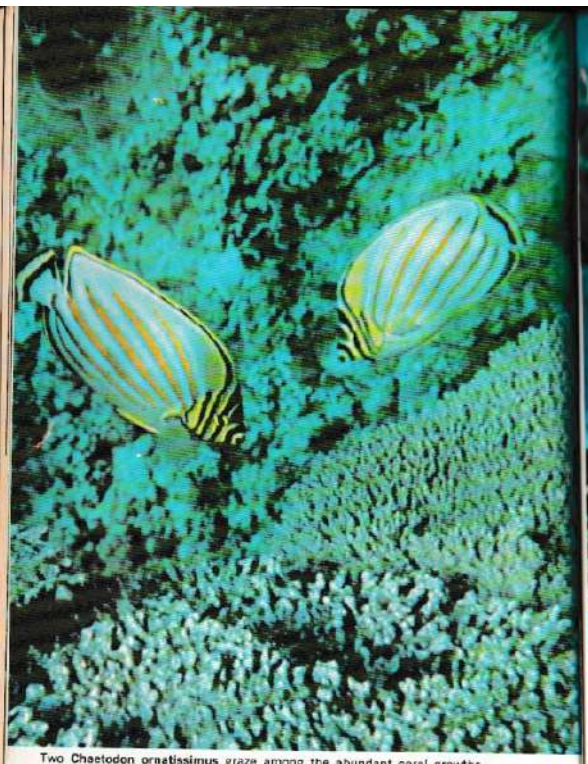
The University of Hawaii had previously conducted a study at Johnston to determine the effects of extensive dredging upon the lagoon environment. We brought along a copy of the published results of the study, which contained descriptions of the various reef areas as well as lists of the fishes which had been collected or observed. We were especially anxious to observe, photograph, and collect the butterflyfishes and angelfishes. The specimens and data were needed in connection with the forthcoming revisions of the butterflyfishes and angelfishes by one of the authors, Warren E. Burgess. Of special interest to us were Thompson's butterflyfish, *Hemitaurichthys thompsoni*, and two species of angelfishes, the beautiful red flame angelfish, *Centropyge loriculus*, and the coquette, *Centropyge nigriocellus*. In addition to our scientific work, we had hopes of bringing back some rare "jewels" for our marine aquaria.

We caught our first glimpse of the island as the plane made a wide bank and began to descend toward the emerald lagoon below. As we made our approach the cabin steward reminded us that since Johnston Island was a maximum security base, picture taking was strictly prohibited. We had received permission to bring along our Nikonos underwater cameras under the condition that no pictures would be taken above the surface. From the air we could see that there were actually four islands in the lagoon: the main island, which was by far the largest (about one mile in length); Sand Island, lying nearby; and two small man-made islets in the northern part of the lagoon. Johnston is an atoll, but not in the strict sense of the word. It might well be called half an atoll, since the fringing reef is developed on only one side. There is no deep lagoon area in the center; instead, the reef gradually drops away to deep water on the southeast side. As we neared the island

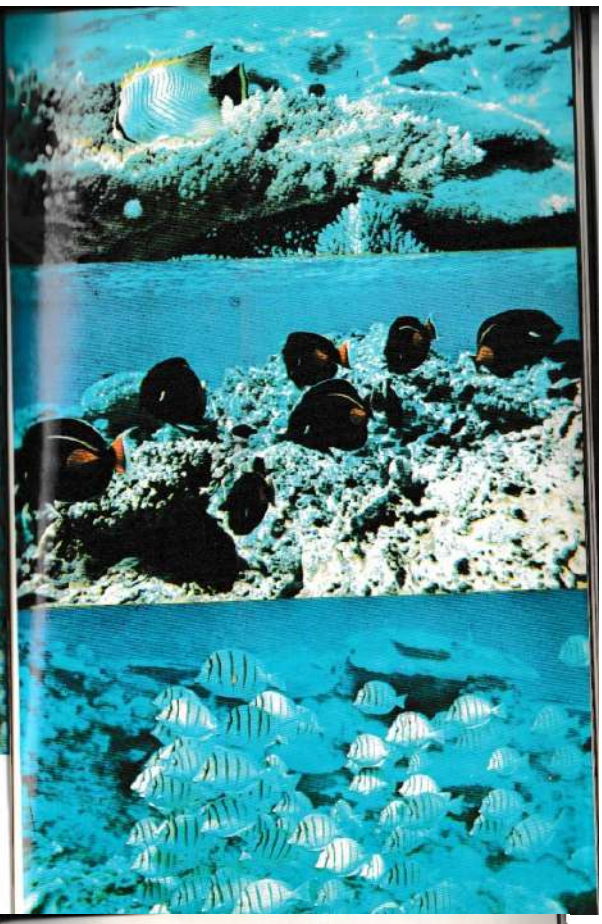
we were able to see the beautiful growths of coral. The water was remarkably clear.

Although we were itching to get into the water, we had to wait until the following day. We first had to arrange for sleeping quarters and boats for our work. We paid our respects to the Commander that afternoon. He was very helpful and promised to have two diving skiffs ready in the morning and to provide us with two experienced divers who were familiar with the area.

The next morning we were up at the crack of dawn, and after a quick breakfast we met the divers at the dock. We were accompanied on the trip by Ralph Bowers and Bill Hashimoto of the Marine Toxins Program. Although the early morning chill slowed our steps, our spirits rose as the sun gained in strength. Soon afterwards we were skimming across the placid lagoon. It was a magnificent day! This first morning after setting the eel traps we had planned to split up; Ralph and Bill would go to spear eels and the two of us would try our luck at collecting butterflyfishes and angelfishes. We dropped anchor just inside the fringing reef off the southwest end of the island. The water was extremely clear as we gazed at the shimmering coral beds beneath the boat. We were in the water almost as soon as the anchor touched bottom, equipped with dipnets and our squeeze bottles filled with quinaldine, the anaesthetic we used for collecting fishes. The scenery was fantastic! The abundance of table corals (*Acropora*) was amazing. This genus is totally absent from Hawaii, although fossil records indicate it once occurred there. We immediately recognized many "old friends" familiar to us from our Hawaiian diving. Schools of convict tangs, *Acanthurus triostegus*, swarmed over the reef grazing on tufts of algae. In the shallower areas of the reef top, the Achille's tang, *Acanthurus achilles*, was abundant. The brilliant red-orange spot near the base of the tail is an unmistakable character for identifying this species. The butterflyfishes were basically the same as those found in Hawaii, but their relative abundance was different. For example, the citron-yellow butterflyfish, *Chaetodon citrinellus*, is relatively common at Johnston but is rare in the Hawaiian Islands. Other butterflyfishes such as the millet-seed butterflyfish, *C. miliaris*, very common in the Islands, is absent at Johnston, and the chevron butterflyfish, *Megaprotodon strigangulus*, plentiful at Johnston Island, has never become established in the Hawaiian Archipelago. This species seems to be tied ecologically to the table coral. We discovered that the juveniles seek refuge by hiding between the horizontal shelves of the coral. After about two hours of diving we had captured eight of these handsome juveniles and several *C. citrinellus*. We also spotted several flame angelfish, but they were extremely wary and led us on a futile chase in and out of the labyrinth of holes in the reef. They managed to avoid our nets but not the camera lens. The incoming tide began to reduce our visibility, so we decided to move on to a new area.



Two **Chaetodon ornatissimus** graze among the abundant coral growths in search of food. Photo by Warren Burgess.



Opposite, top to bottom: **Megaprotodon strigangulus, Acanthurus achilles, Acanthurus triostegus.** Photos by Gerald E. Allen.

After a ten-minute boat ride to the north end of the reef we found ourselves in crystal-clear water once again. The visibility was well in excess of 100 feet! The table coral growth was even more luxuriant than at the previous spot. Individual heads measured 12 to 15 feet in diameter, and fishes were more numerous. Immediately after entering the water, we were greeted by a curious five-foot shark, *Carcharhinus amblyrhynchos*, which made a quick pass and disappeared over the horizon. We saw very few sharks on this trip, since all our diving was confined to the shallow lagoon reefs. It is no secret, however, that a large number of sharks are present in deeper water on the seaward side of the reef. They are commonly caught there by hook and line. We spent the rest of the afternoon photographing the fascinating aquascape. One fish that posed for our cameras was the solid black Thompson's butterflyfish. In Hawaii, this species is rare and usually found in deep water. It was surprising to see it at a depth of only ten feet. This species was reported as being common at Johnston Island by several of our colleagues, but we only saw one. *Centropyge loriculus* had also been observed to be relatively common, but we counted only five during our stay. It appears that the abundance of a species in an area may depend solely on being at the right place at the right time.

Several days later we made a dive in the shallow waters around Sand Island. The visibility was poor and coral growth was sparse. We scouted the area and soon spotted several small saddleback butterflyfish, *Chaetodon ephippium*. They were a perfect size for the aquarium, and we vowed not to leave until we had some of them in our collecting buckets. After several hours we had five small (one- to two-inch) specimens and happily returned to the dock. On this particular outing we also collected two species which had not previously been reported from Johnston Island: *Pervagor spilosoma*, a filefish known only from Hawaii, and *Arothron hispidus*, a puffer or blowfish which is widespread in the tropical Pacific. The total number of fishes known from Johnston now stands at about 190, a number far below the 450 or more inshore species known from the Hawaiian Islands. This disparity is no doubt caused by the difference in available habitats between the two areas and the difficulty in collecting on the outer reef edge at Johnston Island.

Our stay on the island came to an end all too soon. Although the trip had been brief, it was successful. We had collected approximately 35 large eels and many butterflyfishes. We froze some, and shortly before our departure we packed and oxygenated the live fish, and in a matter of hours they were swimming safely in our tanks back in Honolulu.

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PHOTOGRAPHY FOR AQUARISTS—7

XIII

THE RANDALL TECHNIQUE*

BY Dr. John Randall

While conducting a marine biological survey in the Virgin Islands, a successful technique for photographing the colorful fishes of the area has been devised. A fish is brought to the laboratory from the field as rapidly as possible—sometimes alive in a bucket, but usually freshly dead in a small portable ice box. It is laid in a wax-bottomed pan and the fins are pinned in erect position with slender, non-corrosive insect pins.

Formalin is applied with a fine-bristle brush to the fins including the axillary surface of the pectoral fin. If applied only to the outer surface, this fin may elevate when the fish is placed in water in the photographic tank. Tears in fins may often be repaired by careful pinning. Additional pins and formalin application may be necessary to depress a gill cover, alter the gape of the mouth, straighten the body, etc. Within a few minutes, depending on the size of the specimen, the pins can be removed and the fins will remain in the desired position. Excess mucus is carefully washed from the specimen, and the fish is then placed in a water-tight, glass-bottomed box located over a cut-out section of a plywood table.

*Reprinted from COPEIA, 1961, No. 2, pp. 241–242, June 19

This article is the concluding installment in a series of chapters adapted from the T.F.H. Publications book Photography for Aquarists, *by Dr. Herbert R. Axelrod. These articles are intended to be of special use to hobbyists who know something about fishes and their care but almost nothing about photography. The book is available at pet shops for* $2.00.

The fish is then covered with several inches of water, thus eliminating the surface reflections which result when a wet fish is photographed in air (admittedly fishes can be dried before photographing them, but their life-like qualities may be lost). If the fish tends to float, a slit into the airbladder on the far side and application of pressure to the abdomen will usually expel the gas. It is advisable to perform this in a separate container of water to avoid fouling the water in the photographic tank. A brush is used to sweep dirt particles that do find their way into the tank out of the photographic field.

Photoflood lights are directed on the specimen from the sides of the tank. The camera is placed on a stand built vertically from the table behind the tank. Depending on the location of the lights and other factors a reflection may be seen in the field from the bright metallic surfaces on the front of the camera. This difficulty may be obviated by painting these bright areas with flat black paint or placing a piece of black cardboard in front of the camera with a hole for the lens. A reflection of the photographer's hand when pressing the shutter may appear in the picture. To avoid this, a long cable release of a long stick painted with black paint may be used to trip the shutter. Background is provided by a masonite board painted with flat paint. The board is placed on the floor two to three feet beneath the table. Generally a color is chosen that is complimentary to that of the specimen. For best results the background should be illuminated separately (unless black). The glass bottom of the tank serves to admit background color and eliminate the shadow of the fish.

Charles E. Cutress of the United States National Museum has utilized another method for achieving uniform colored backgrounds without shadow effects. A clear sheet of colored plastic or glass is placed in the bottom of the tank or mounted beneath the tank. Light is directed upward from beneath the tank. A sheet of diffusing glass or plastic is located above the light source to remove "hot spots." The saturation of color in the background can be altered with a change in light intensity. Different colors for the background may be obtained by combining the colored plastic sheets.

Still another method developed by Cutress has the advantage of only requiring light sources from above. A diffusing sheet of plastic or glass and a colored sheet are placed above a mirror and the specimen in turn placed on the colored sheet. Light sources not only illuminate

the fish but are reflected upward from the mirror to provide the colored background.

Not infrequently fishes are damaged in their capture or handling and lose scales or are scratched, thus reducing their value as photographic specimens. At times it is possible to replace lost scales from ones on the opposite side. With use of indelible colored pencils, scratches may be touched up directly on a wet fish. If the fish is allowed to dry briefly and placed slowly into the water, a photograph can usually be taken before the color diffuses away.

It may be necessary to alter the direction of floodlights to provide uniform illumination to a large fish. A light meter is useful to test the level of illumination over the surface of the fish.

"I still say it's only a matter of time before the humane society gets wind of what you're doing with that electric eel."

MAIL CALL

If you have an aquarium question that you would like answered, send it to MAIL CALL. Each month the most interesting questions received and their answers will be published in this column. Letters containing questions cannot be acknowledged or answered personally. Address all questions to: MAIL CALL, T.F.H. Publications 245 Cornelison Avenue, Jersey City, N. J. 07302.

Q. About three months ago I started experimenting with hatching brine shrimp. I tried everything from a quart canning jar to a gallon pickle jar but have had trouble with the eggs settling here and there on the bottom of the jars in bunches even with the use of an air stone under high pressure.

Finally about a month ago a fish dealer dug out of her closet a cone shaped brine shrimp hatcher. With this hatcher an air stone is not even needed. Just by positioning the air hose down in the end of the cone with a minimum of pressure the eggs can be kept circulating all of the time. My problem is that I would like to have at least one or two more of the hatchers but have been unable to locate any from most of the dealers located in our area.

Can you tell me of anybody who sells this type of hatcher and if it might be homemade?

There is an outside frame that the cone sits in.

Ronald V. Hedges
Galion, Ohio

A. Yes, a few companies make them. Your best bet is to order them from ads in the magazine or check with the members of an aquarium society in your area. A list of aquarium societies appeared in the March, 1970 issue.

Q. I recently purchased a fish called an African reed fish, and I would appreciate any information on it, scientific name, mature size, feeding habits, etc.

David Shur
Los Angeles, California

Calamoichthys calabaricus

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I do most of my fishing, and this stream is full of carp. About one out of every five carp I catch has a large fan-type tail. Is this a common occurrence among carp, and are fantailed carp caught wild worth trying to breed? Some that I have caught weighed almost five pounds.

Steve Viola
West New York, New Jersey

A. *Fantailed or not, wild carp are not good subjects for the home aquarium or even for an outdoor pool; they are much less attractive than the colorful long-domesticated carp species like goldfish and koi, for one thing. There is probably no good reason to try to develop an aquarium strain from them, and at present they are worthless on the aquarium market.*

Q. I have a particular problem with my angelfish. At this point, my losses have been minimal, but I am quite concerned. I keep ten to twelve angelfish in a 29-gallon tank. The fish are of varying ages, from six months to one and one-half years old. Thus far I have lost three black lace and one marble angel over a two-week period; there are no adverse signs showing in my blushing and normal angels.

The symptoms are that the sick fish leaves the others and goes off by itself. Generally it stays alone in a corner and moves only when frightened. There appear to be no visible signs of disease except that the body or the snout part of the head seems to become elongated. During its final hours the fish is usually at the surface gasping. It appears to take four or five days for this disease to run its course. Can you help me?

Donald R. Marich
New Rochelle, N.Y.

A. *It sounds as if your fish are being poisoned or are off their feed. You did not tell me the condition of the water, but perhaps your fish need a change of water and some good feeding.*

You should alternate feeding with live food and freeze-dried food. While angelfish will eat the usual dry foods, they cannot digest them properly unless they receive the additional vitamins that are found only in live and freeze-dried foods.

Q. I have a copy of your new looseleaf book *Exotic Marine Fishes*, which I received for Christmas. While I enjoyed very much reading it, I am afraid I don't quite understand everything in it. For example, under the "Palau Squirel" on page 165 under the "Meristic Characteristics" you have D. X-XII, i, 13; A. IV, 9; P, ii, 13; 47–51 perforated scales in the lateral line." What does it all mean?

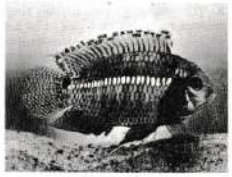
I would also like to suggest to you that you put a plastic cover under the hoods that you sell to keep water from condensing on them and ruining them.

Robert Suchevits
Uniontown, Pa.

A. *In the "Meristic Characteristics" capital* **D.** *stands for dorsal fin and the X-XII, i. 13 means that there are 10 to 12 large spines, one soft spine and 13 branched rays in the dorsal fin. The* **A.** *stands for the anal fin and* **P.** *stands for the pectoral fins. The numbers following these initials merely indicate the number of rays or spines. The statement "47-51 perforated scales in the lateral line" means that if you examine the fish closely you will find, along the fish's lateral line, a series of scales with holes in them. If you count the number of these scales you will find that there are 47 to 51. Characteristics such as scale and fin ray counts are used to identify fishes.*

The reason we don't recommend a guard against evaporation on your aquarium in the form of a clear plastic barrier between the aquarium and the reflector or hood is that plastic cuts down on the light, especially the part of the light that makes the plants grow.

Aequidens portalegrensis, showing fin ray counts of dorsal fin



Q. I bred a Cambodia male with a blue female and at six months some of the resulting fry have deformed tails. The tail fin bends at a 90° angle where it joins the body. I used the female with a different male and produced a healthy batch. Will this defect affect future spawns?

Joe Zeller
Chicago, Illinois

A. *It is impossible with this limited information to be sure that the defect is hereditary and, if it is hereditary, whether it is the result of combining a number of genes from each parent or whether it is the result of a single gene. The safest thing is to not use the parents or their fry for breeding purposes.*

Q. I have an 8-gallon betta aquarium which has eight sections. Would it be possible to remove some of the partitions and use part of the aquarium for breeding while adult bettas are in the other sections?

Mark Tracy
El Monte, California

A. *This would be an undesirable set-up for a number of reasons, the most obvious of which is the fact that the fry could get through the spaces between the partitions and the glass and be eaten by the adults. Secondly, there would not be enough space to keep the fry for any length of time.*

BUG CATCHER

Fresh insects make a good diet change for most fish. Catching them can be made easy by using an electric fan, a light and an old nylon curtain.

Sew the curtain to make a bag a little larger than the diameter of the fan guard. It should be about fifteen inches long. Fasten the bag to the front of the guard of the fan with safety pins. Put the light behind the fan and place the whole setup outside. At night as the bugs are attracted to the light, the fan will pull them into the bag. As you can imagine, after going through the fan, the bugs are usually in no condition to fly. An hour's worth of collecting can then be sorted out and dropped into the tanks. Fresh insects for your fish with no worries about smelly cultures or escaped bugs. Just a few worries about what insecticides the bugs might have picked up on their way to your fan.

By Ed Gralewicz

cichlid nOtes

Robert J. Goldstein, Ph.D.

The dwarf cichlids of the genus *Apistogramma* REGAN are both numerous and difficult to identify. I was therefore very pleased to receive a packet of reprints from the authority on the genus, Hermann Meinken. Included was Meinken's key to the genus, based on characters that any aquarist can make use of, provided he has a simple set of calipers and a small metric ruler. After your fish has died, you should use the calipers to measure the diameter of the eye and the distance from the tip of the nose to the eye (snout length). Although this system gets you to the sub-group within *Apistogramma* (and this is a pragmatic subgroup, not a biological category), it still doesn't get you to the exact species. Nevertheless, a person is able to eliminate a lot of species names from consideration, and that in itself is a big help.

KEY TO THE GENUS
APISTOGRAMMA

1. Snout length of male and female greater than diameter of the eye—
   A. Caudal of male rounded . . . no species known.
   B. Caudal of male with elongated fin rays above and below (lyretail pattern).
      ortmanni (Eig., 1912)—Brit. Guiana, Amaz.
      teichleri Meink., 1960—Guiana?
2. Snout length of male and female equal to eye diameter—
   A. Caudal of male rounded; forward dorsal spines not elongated.
      amboplitoides Fowler, 1939—Peruv. Amazon
      hoignei Meink., 1965—Venezuela
      steindachneri? (Regan, 1908)—Demerara(?)

   B. Caudal of male with elongated rays above and below; fifth to eighth dorsal spines elongate.
      cacatuoides Hoed., 1951—Dutch Guiana
      klausewitzi Meink., 1962—middle Amazon
      kleei Meink., 1964—Amazon?
      ornatipennis Ahl, 1936—Brit. Guiana
      roeglesi Meink., 1961—Peruvian Amazon
      t. trifasciatum (Eig. and Kenn., 1903)—Par.
      t. haraldschultzi Meink., 1961—Matto Grosso
      t. maciliense (Haseman, 1911)—mid. Amazon
3. Snout length of male and female less than diameter of the eye—
   A. Caudal of male rounded.
      a) forward dorsal spines not elongated.
         aequipinnis Ahl, 1938—La Plata basin?
         amoenus (Cope, 1872)—Ambyiacu and La Plata
         commbrae (=*corumbae?*) (Reg., 1906) — Mat. Gros.
         pertense (Haseman, 1911)—mid. Amaz., Tapajoz
         pleurotaenia (Reg., 1909)—La Plata, Par., Braz.
         reitzigi Ahl, 1939—Paraguay
      b) fifth to eighth dorsal spines elongated.
         ramirezi Myers and Harry, 1948—Rio Meta
         parva Ahl, 1931—lower Amazon, Paraguay
         taeniatum (Günther, 1862)—Parag. Amazon
   B. Caudal of male with elongated rays above and below; fifth to eighth dorsal spines elongated.
      borelli (Regan, 1906)—Paraná, Matto Grosso
      rondoni Miranda-Ribeiro, 1918—Matto Grosso
      ritense? (Haseman, 1911)—Paraná, Paraguay

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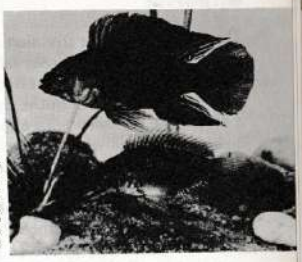
C. Caudal of male with central rays elongated.
  a) no elongated dorsal rays.
    agassizi (Steind., 1875)—Amazon, Paraná to Paraguay
    gibbiceps Meink., 1969—Rio Negro
  b) fifth to eighth dorsal spines elongated.
    weisei Ahl, 1935—middle Amazon (=*Taeniacara candida* Myers, 1935)

RELATED SPECIES: *Apistogrammoides pucallpaensis* Meinken, 1965.

The aquarium handling of apistogrammas is different from the handling of most other cichlids. The water should be neutral or nearly so, and the tank quiet, well-planted, and well-lighted. Mild undergravel filtration is desirable, but heavy aeration is to be avoided. Some floating water sprite, anacharis, *Hygrophila* (both rooted and floating), and a heavy planting of *Vallisneria*, plus a clearing make for a very nice set-up. An aquarium of 5 or 7 gallons is sufficient for a pair, but larger tanks with several pairs are even better. A very important consideration is the food. Although the dwarf cichlids will take dry foods, it is much better to give them a diet of living foods only. If all you have available are white worms and newly hatched baby brine shrimp, you will find them sufficient. But if you can also feed tubificids, mosquito larvae, live adult shrimp and/or bloodworms (chironomids), it will be much easier to keep your fish in top shape. Keep the aquarium gravel siphoned regularly.

Under these conditions of maximal cleanliness and living foods, your dwarfs will color up beautifully and grow well. Best of all, they will not succumb to bacterial infections, manifested by light spots on the body, the fish going off their feed, hiding, fin-clamping, and other symptoms associated with decreased vigor. And if your fish are healthy, then they will certainly spawn. If you are impatient for a spawning to take place, try raising the temperature to the low 80's. Most dwarfs spend little time preparing a spawning site, and the presence of a batch of eggs in the sand, on a rock or flowerpot, or on the glass of the aquarium often comes as a complete surprise to the aquarist. In most cases, the eggs of the first batch should be removed for artificial incubation. When you've got all the fry you want, then you can let the parents attempt to raise their own. But I recommend that YOU be the guardian of the first batch.



Apistogramma reitzigi. According to the key, A. reitzigi would be one of six **Apistogramma** species in which the males have rounded tails and are further characterized by having a snout length shorter than the diameter of the eye (both sexes) and non-elongated forward dorsal spines. Photo by M. Chvojka.

editorial

The New York State Division of Fish and Wildlife, an adjunct of the State Conservation Department, recently issued a directive that in effect bans the ownership of piranhas by aquarists in the Empire State. It requires a permit for the ownership of piranhas beginning July 1 and gives people who now own piranhas until December 31 to get rid of their unlicensed piranhas.

It would be easy to ridicule the law. We could point out, for example, that since the lower reaches of the state's major waterway are so polluted (one wag has said that the Hudson River at New York City is the only body of water in the world that constitutes a fire hazard) it can safely harbor almost no worthwhile fish life, any piranha that could live there should be given a medal, not the bum's rush. We could criticize the political maneuverings involved that went on prior to enactment of the law. We could mention the inconsistency of the state's conservation policy as regards fish life.

But the goodness or badness of the law is not the point. Although the director of the Division of Fish and Wildlife has himself stated that the chances of having piranhas survive in New York waters are considered remote, maybe they're not remote enough. Who knows? Maybe there really is a danger. Maybe the anti-piranha directive, instead of being the piece of bureaucratic lunacy that it appears to be, is sensible.

Nor are the immediate effects of the directive the point. If the directive serves a truly necessary function in protecting New York citizens and fish life, the economics of the tropical fish industry don't rate prime consideration. Also, no one is going to drop dead by being deprived of the keeping of piranhas.

Continued on Page 87

Continued from Page 82

The point isn't even that hobbyists have been ineffectual in preventing the commission of what many consider to be a disservice to them. In a purely political sense, the drag of hobbyists who didn't want the law was measured against that of those who did, and the hobbyists lost.

The point is not what hobbyists have lost, if they've lost anything at all: it's what they stand to lose. It is a fact that governmental bureaus of any sort, in any place and any time, fatten on their powers, growing more self-important all the time. And it is a fact that the type of mind that can produce something like an anti-piranha law for New York will, in its frenetic vote-sucking among the naive, eventually come up with something lots worse. Count on it.

Neal Pronek

killie Corner

Robert J. Goldstein, Ph.D.

There are two principal kinds of diseases that may afflict killies. The first, and most important of ALL diseases of killies, is velvet or rust disease, caused by the dinoflagellate alga *Oodinium limneticum*. Velvet is rarely encountered on the South American soilbreeders, but it is very common on the species of *Nothobranchius* of East Africa. Is velvet serious? Is it an aquarium phenomenon? The answer to both questions is: yes and no! I have had tankful after tankful of different species of nothos come down with velvet, and only occasionally did it seem to do them any harm. If your water is green (and this often happens when you keep the light on for 24 hours a day and feed very heavily) your fish seem to be totally normal in behavior, despite the massive numbers of velvet organisms on their bodies. Velvet is a byproduct of uneaten food residues in the aquarium. Perhaps the causative organisms multiply under the very conditions that stimulate the growth of non-parasitic algae: plenty of nutrients in the water. So in the large growing tank, the presence of some velvet should not cause a great deal of concern. In the breeding aquarium, however, it is another matter entirely. You must assume that if velvet is growing, so are all kinds of bacteria. All these organisms are producing metabolic wastes. In the breeding aquarium (a 2-gallon jar perhaps), not only may velvet drain vigor from the fish but also the associated bacteria probably kill the notho eggs with their waste products. Stir up the sand or the peat moss. Does it smell bad? If so, then most of the eggs are probably already killed. You have been over feeding, and the leftover food has been attacked by bacteria. Change the entire aquarium. And now, the water change will often weaken the fish and the velvet might become more serious; you should treat your

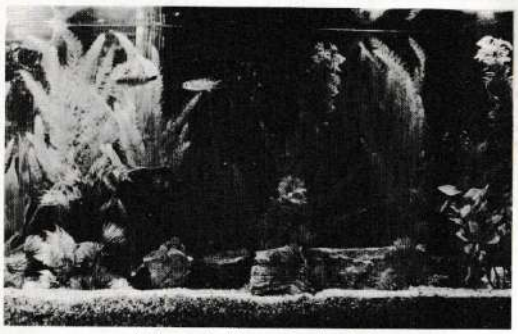
fish to get rid of it. Use copper or malachite green, and no other drug. How much copper? This varies with the quality of the water. I keep adding copper solution until the dust-fine parasites fall off the fish, or until snails in the aquarium (yes, I keep snails in many of my breeding tanks) stop moving and either stick to one spot on the glass or fall to the bottom. You can use a copper sponge the same way. Always watch for the disappearance of the velvet, and stop adding copper at that point. Too much can kill your fish.

Malachite green is used in different ways. If you are patient, you can add one drop of a 0.75% solution per gallon of aquarium water. If there is peat moss in your tank, this is a waste of time, as the dye will be taken up by the peat moss instead of the parasites. A better method is to use the straight, concentrated aquarium remedy and pour it into a little cup. Take your fish in a small net, and dip it into the concentrated solution for a full second or two. Then place the fish in a new aquarium, as the old one will have to be torn down anyway. This method is very effective. Aquarists are always calling me up saying: "I can't find malachite green at the pet shops. All they have is *Ich-Smash* and *Velvet-Whallop*." Nuts! All pet shops have malachite green. The aquarist should look at

the ingredients on the label, not at the brand name.

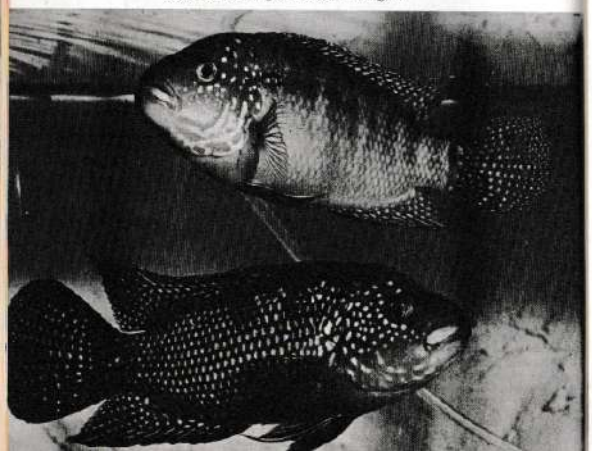
The other disease afflicting killies, especially annuals from South America and East Africa, is mycobacteriosis, an infection with acid-fast bacteria of the genus *Mycobacterium*. Infection is usually seen as a sore on the body, often with slight bleeding, but the bacteria are actually inside the internal organs as well. Acid-fast bacteria mostly attack old fish, and it is not worth your while to attempt treatment (which takes a long time and is very expensive). Such fish should be humanely killed. There is no point in prolonging their suffering.

Contest Winners



Landscape: Paul Rowan, Rye, New York.

Closeup: Joe Unger, Romeo, Michigan.



Anesthetics for Aquarium Fishes

BY DR. HERBERT R. AXELROD

Many of the anesthetics used for human beings and other warm-blooded vertebrates such as dogs, cats, mice, hamsters and gerbils have been used with great success on fishes. Some investigators will surely begin the reverse process and begin using fishes as test animals for proposed new anesthetics for mammalian use. In the interim, the use of certain anesthetics, or "tranquilizers" as they are called in the fish trade, enables fish shippers to put more fish into a given quantity of water. The successes and failures and the lack of industry standards have unfortunately added little to the general knowledge of fish tranquilization, and this paper intends to review all the known (published) drugs used for fish anesthesia and to discuss their potentials as fish tranquilizers.

It should be carefully borne in mind that there is a great deal of difference in the various chemical and bio-chemical reactions between the drug and the test animals because of such variables as body weight of the fish, concentration of the drug, longevity of exposure, pH and chemical composition (especially hardness) of the water, water temperature and purity of the drug.

Before any drug is used commercially, it is highly recommended that each species and variety of fish be tested specifically with the drug to be used. Green swordtails *(Xiphophorus helleri)* and Berlin Swordtails *(X. helleri)*, both of the same species, but considerably different in appearance, have different reactions to the same drug. Swordtails one inch long react completely differently from the way mature, three-inch-long fish react. At Gulf Fish Farms, where we experimented with various tranquilizers for many years, we found that we had the most success with using drugs that only slowed the fish down rather than immobilized it. Tests were very satisfactory, however, when we kept the fish under anesthesia until it was immobile and then put it into shipping water which held a much lower concentration of tranquilizer, thus allowing the fish eight to twelve hours to recover from the anesthesia.

Tranquilizing fish in order to photograph them is a technique in wide use by most fish photographers and is just one of many practical uses.

HOW DRUGS WORK

General anesthetics (as distinct from local anesthetics) have a cumulative effect. The more anesthetic applied, the deeper the effect. Specifically, the first area to be anesthetized is the brain's cortex, followed by the basal

ganglia and the cerebellum; finally, the spinal cord is affected. For fish shipments, the objective is merely to have the cortex affected.

Should there be too much drug applied, or should the drug be applied for too long a period, the medulla area of the brain is affected, altering the autonomic nervous system and causing paralysis of the vital respiratory processes, thereby killing the affected fish. Since general anesthetics affect the central nervous system, all general anesthetics are potential killers of fish.

Hypothermia, lowering the body temperature of a subject animal to a sub-normal range, is used regularly for its anesthetic effect by shippers of coldwater fishes such as goldfish, carp, trout and salmon. It is usable by tropical fish shippers only in cases where the temperature is lowered slowly to about 60°F. Lower temperatures (below 48°F.) for extended periods of time usually kill tropical fishes.

TRANQUILIZERS USED

Carbon dioxide

Dr. F. F. Fish, writing in the *Transactions of the American Fisheries Society Journal* in 1942 (**72:** 25–29), described the use of high carbon dioxide concentrations as a fish anesthetic. It is, of course, a cheap way to kill fish as well, when the fish are used for bait, preservation for further study or for any other reason where disfiguration must be kept to a minimum. Carbon dioxide is available in tanks and sold to soda fountains. Small cartridges are also available for home "seltzer" machines. For fishes, merely place the fish in a collapsed plastic bag and inflate the bag with pure CO_2 gas. About 7% of the gas dissolves in the water. The fishes become immobile within 120 seconds or so after swimming nervously, surfacing and gradually falling or floating, almost as though dead, to the bottom of the water. After three minutes of immobility they are dead. Revival for most must be accomplished in clean, aerated water within 180 seconds of immobility for a high recovery rate.

The use of CO_2 is not recommended for fish transport. It is recommended for fish photography, fish preservation and for killing fishes in quantity.

Chloral hydrate

W. N. McFarland in 1959 published a paper titled "A Study of the effects of anesthetics on the behavior and physiology of fishes" (Pub. Inst. Marine Sci., **6:** 23–55) in which he tested 15 anesthetics on *Fundulus*, *Girella* and *Paralabrax*. Chloral hydrate is also known as trichlorethylidene glycol and somnos. Its chemical name is trichloroacetaldehyde monohydrate, with the formula CCl_3-$CHO.H_2O$, and it is a solid. Most laboratory supply houses or wholesale druggists have this material, which costs about $5 per pound. Light breaks it down, so keep it in a dark bottle protected from light. It is dangerous, so keep it away from children.

The recommended dosage is about 10 grams per gallon of water. The fish become immobile in 120 to 200 seconds. Greatly reduced dosages are recommended for fish transport, and experimentation to determine optimal dosage for each species is recommended.

Chloral hydrate has long been used as a hypnotic drug for human beings. It affects the human heart by slowing it down and lowering blood pressure. It reduces consciousness and affects respiration, two of the most important assets for fish transport. If this drug can be carefully administered it can be most economical for fish transport.

The cost of the drug is less than 10c for a bag of fish containing about a gallon of water. I have successfully shipped as many as 800 swordtails in three quarts of water for 48 hours in chloral hydrate-treated water. Too much drug is absolutely lethal.

Chloretone

This drug was first reported in 1953 by P. R. Nelson in the *Progressive Fish Culturist* (**15:** 74); it was used on young salmon and trout.

Chloretone is also known as methaform, Sedaform and Chlorobutanol. Its chemical formula is Cl_3C-$C(CH_3)_2$-OH. It is a solid. It costs about $10 per pound and is best dissolved in ethanol. Although the drug is relatively stable, it can burn your skin and be very poisonous if ingested; 10 grams (about ⅓ ounce) will kill a man.

This is a good drug for tranquilization of fishes. It should not be used in dosages stronger than 1:10,000 and requires careful testing with each species of fish. It acts very much like chloral hydrate in all respects, taking 120 to 200 seconds for immobility. The great advantage of this drug over most others is that it kills bacteria, thus preventing most fish diseases that might occur during shipping. I once used much too much drug in the early stages of experimentation and found that after five weeks the fishes in the plastic bag containing 1:100 were almost perfectly preserved! This drug might someday be the drug of choice for fish shipments.

Ether

This drug is probably the most well known drug used to anesthetize people, even though an overdose is lethal to all animals. Griffiths, Webb and Schneider first suggested the use of ether on fish in 1940 in the *Transactions of the American Fisheries Society*. Their test animal was the steelhead trout.

Ether is known chemically as ethyl oxide C_2H_5-O-C_2H_5 and is a light liquid weighing about 71% as much as water. A quart costs about $2. Ether is very dangerous because it is volatile and must be used only in well aerated surroundings. Do not smoke while using ether! Using one ounce to a gallon will kill most fish; half an ounce per gallon is safe for most fish, so you have the ranges in which to experiment. It is very useful for transporting fishes in the jungle, since the ether can be removed from the shipping water in a few minutes when the plastic bag is opened and heavy aeration supplied

with the usual aquarium air pump and air stone. Use in cases where you want to re-use the water in which the fishes are shipped. It is only because the drug is dangerous (explosions) to use that it is not highly recommended. It would be especially dangerous to use ether for shipping fishes on airplanes, as it might explode with disastrous results!

Methylpentynol

In *Science* magazine, Margolin, Perlman, Villani and McGavack described "A new class of hypnotics: unsaturated carbinols." Their test animals were dogs, rats and humans, but subsequently Norris and McFarland (and others) recommended methylpentynol for transporting fish.

Methylpentynol is also known as Somnesin, dormison and oblivon, and its chemical name is methylparafynol. It weighs about 87% as much as water. The Air Reduction Chemical Company manufactures the liquid, and it is available for about $100 for a 5-gallon drum.

When used at a level of about 2cc per gallon it slows the fish down in three to four minutes. Some fishes react violently to the drug and may harm themselves in their frantic thrashing, but otherwise it is an almost perfect drug for shipping fishes or for fish photography. It is not, however, recommended for fish surgery, as it doesn't bring the fish deep enough into a state of relaxation.

Do not use the water in which this liquid is dissolved, as it foams when aerated! Be careful not to get any into your eyes, as it may damage your eyes if direct contact is made.

This drug is a drug of choice for shipping tropical fish.

M.S. 222

M. Y. Sandoz first reported on this drug and its potential affect upon coldwater animals in 1920. Since that time there has been extensive literature on M.S. 222, and many fish shippers have experimented with the drug.

The chemical name of M.S. 222 is tricaine methanesulfonate. It is available from Sandoz Pharmaceuticals, Hanover, New Jersey at a cost of about $25 for 100 grams. It keeps well and is not toxic to humans. Many people eat fish which have been collected with M.S. 222, and there doesn't seem to be any problem if the fish are cooked.

For shipping fishes or for fish photography use 1:55,000 down to 1:60,000. With the high concentration it takes about 3 minutes for immobility. It is best used by freezing into pre-measured ice cubes so that one ice cube is added to one gallon of shipping water. Some delicate species are best shipped in 1:60,000 though swordtails, platies, mollies and guppies do well at 1:45,000. I have shipped 800 swordtails in one gallon of water with M.S. 222 at 1:45,000 concentration for 60 hours with success. I have found that at 48 hours there is almost negligible loss of fish.

Many people have tried M.S. 222 for shipping trout and salmon, but they had bad experiences. In warm water M.S. 222 seems to be better. I

use this exclusively for fish photography, using high concentrations to knock out the fish in two to four minutes with great success. In several hundred uses with all kinds of aquarium fishes I have had less than 1% loss. I recommend this drug highly for fish transport.

2-Phenoxyethanol

Sehdev, McBride and Fagerlund have reported the use of this drug (1963) for sockeye salmon anesthetization. It is poisonous and dangerous: 10 grams will kill a man. This drug is excellent for the treatment of certain fish diseases of bacterial origin, but the drug is very "tricky" and not recommended for the beginner.

At concentrations of about 1:10,000 it immobilizes a 2-inch swordtail in four minutes. It costs about $5 per pound (about $1.00 for 100 ml.) and is about 10% heavier than water. Eastman Kodak supplies this drug.

Propoxate

Thienpont and Niemegeers described propoxate (R7464) in *Nature* magazine in 1965 as "a new potent anesthetic agent in cold-blooded vertebrates." They used goldfish, frogs, salamanders, sunfish, trout and salmon as their experimental animals.

Propoxate is a solid and is chemically known as DL-1-(1-phenyl-ethyl)-5(propoxycarbonyl)-imidazole HCl. It is available from Janssen Pharmaceutica, N.V., Beerse, Belgium. This is one of the newer drugs which offers great promise for fish transport. Initial tests show that such small dosages as ¼ ppm allow the shipment of 200 4-inch goldfish to be shipped in one gallon of water for 36 hours. It lowers the use of oxygen in goldfish and seems to be relatively safe to handle. More work is needed to properly evaluate this drug, but it is very promising and should be tested with tropical fishes.

Quinaldine

Quinaldine is the drug most often used for fish transport at Gulf Fish Farms. It was first described by B. Muench in the *Progressive Fish Culturist* (1958; **20**: 42–44), wherein the use and effects of quinaldine on tropical fishes was discussed.

Chemically the drug is known as 2-methylquinoline and is available from Eastman Kodak. It costs about $15 per pound and is a clear liquid when fresh. When it becomes reddish brown it should be discarded, as it has then become oxidized. Use in concentrations of about 1:200,000. Fish do not show signs of stress, nor do they become immobilized with quinaldine. When under the proper dosage, the fish act as in a stupor and are easily caught in your bare hand. Steinhart Aquarium reports using a 10% solution for collecting fishes in the field. There is great margin of safety in this drug, and it is recommended as a general tranquilizer for fish transport.

Sodium Amytal

C. F. Nemoto, writing in the *Progressive Fish Culturist* (1957; **19**: 147–157), describes his experiences in Hawaii using sodium amytal, bone charcoal, buffers and permutit to control levels of metabolic rate and fish wastes in transported fish in sealed plastic bags charged with oxygen. Sodium amytal is a dangerous drug which is fatal to man if improperly used. It is difficult to obtain under most circumstances, but is extremely useful for fish transport. Best results are obtained from 1:10,000 concentrations. The use of sodium amytal is not recommended for general use because it is too dangerous to man. Do not use with hard water or marine fish.

4-Styrylpyridine

This drug was first described for use as a fish anesthetic by Howell and Thomas in 1964 in the *Transactions of the American Fisheries Society* (**93**: 206–208). It is a solid available from Eastman Kodak for about $500 per pound. It is relatively stable and fairly safe to use for humans. Not too much has been done with the drug for fish transport, but a starting concentration of about 5 ppm is suggested. It is suggested that the drug be dissolved in acetone before use, as it is not very soluble in water. It takes a long time to immobilize fish, so its use is limited to fish transport.

When used with 500 platies of about an inch in body size, at dosages of 5 ppm, a normal shipping bag holding one gallon of water and sealed-in oxygen environment kept the fish alive for 83 hours (the control went 50% dead in 13 hours.)

This drug has promise and should be further studied.

Tribromoethanol

McFarland did a lot of work on this drug in the late 1950's. It is also known as Ethobrom, Renarcol and bromethol and the solid can be purchased for about $100 per pound. It is used in very small quantities, probably 1–2 ppm in most cases. In 1:40 solution it colors the water deep Congo red (when it is fresh) and is very unstable. It acts on fishes as chloroform does on people and is very sensitive to water and light.

This drug is too dangerous for humans to be used for fishes. There are better drugs available, but this has one of the highest narcotic potencies of all drugs known to affect fishes.

Tertiary-amyl Alcohol

McFarland reports that this drug is effective for fish transport in a 1–2 ml/gal concentration. It is very cheap, costing about $3 per quart, and it is very stable. Take care that it is not exposed to flame or sparks, as it explodes. Avoid inhalation of the fumes or it gives you a real hangover with a headache that lasts for days!

This might be used for alcoholics better than for fish transport, but when used 50 ml/gal it stops fish in two minutes for fish surgery or photography. It takes fish about 30 minutes to fully recover from the anesthesia when put under the 50 ml/gal dosage.

This drug has shown great promise for the heavy breathers such as barbs and Australian rainbows. Under certain conditions, especially when not properly used (too low a dosage), it stimulates the fish instead of slowing it down.

Read it next month in TROPICAL FISH HOBBYIST . . .

TAIPEI AQUARIUM . . .

by Dr. Herbert R. Axelrod