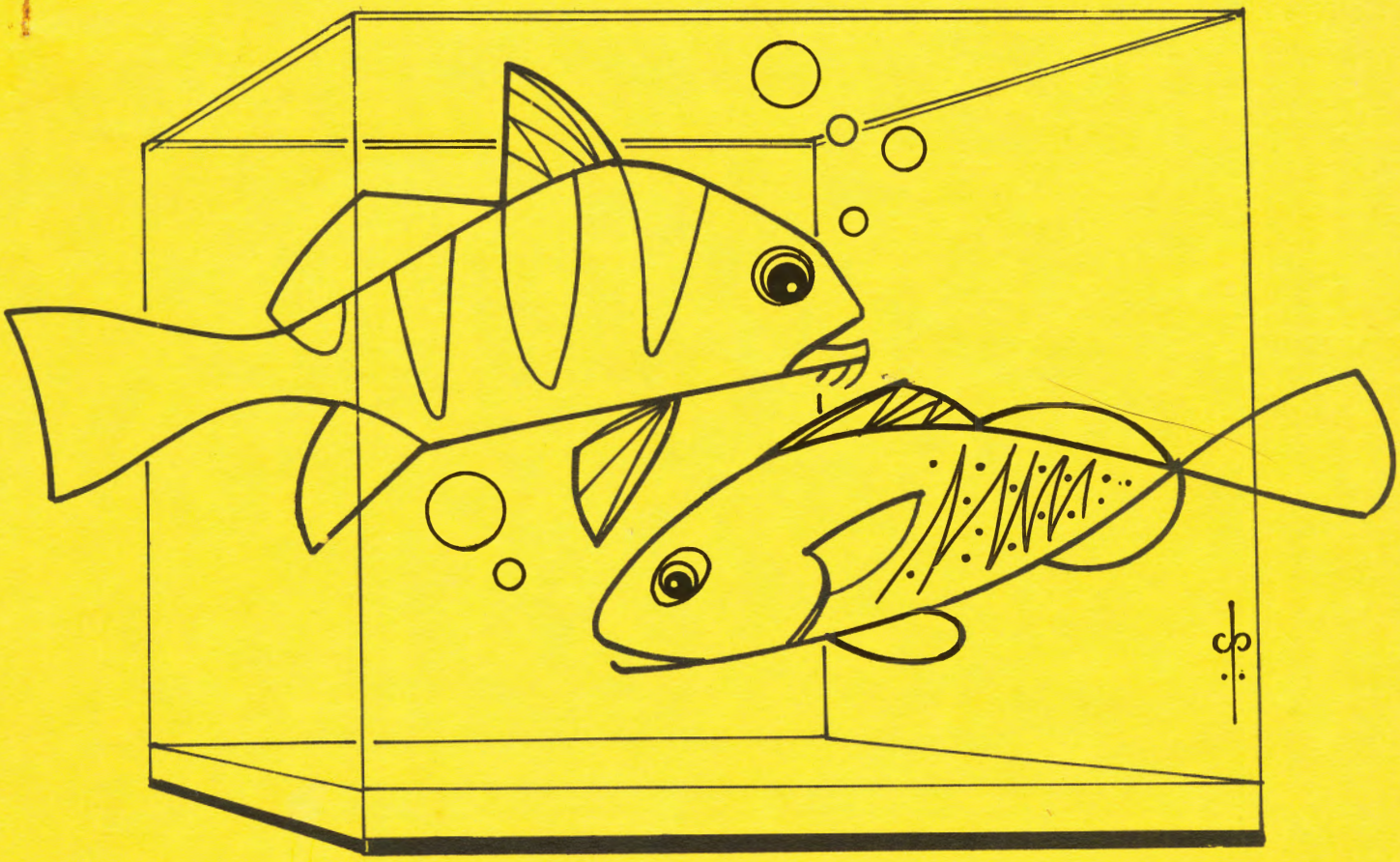
DRUM and CROAKER



VOLUME LXVIII, NUMBER 3 SEPTEMBER 1968

THE INFORMAL ORGAN
OF THE
AQUARIUM RESEARCH SCIENCE ENDEAVOR

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D R U M A N D C R O A K E R

The Informal Organ

of the

Aquarium Research Science Endeavor

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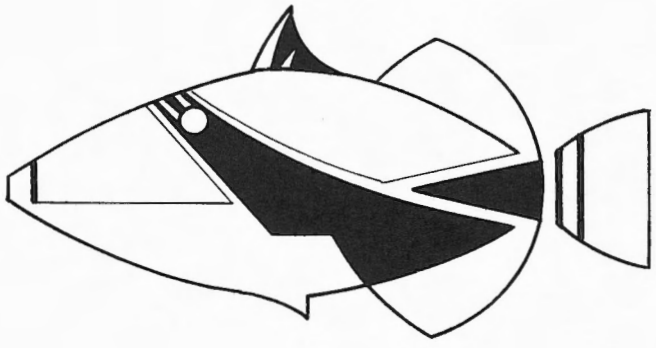
Craig Phillips
Assistant Curator
National Fisheries Center
and Aquarium
Washington, D.C.

Prepared by the National Fisheries Center and Aquarium, U.S. Department of the Interior, Washington, D.C. 20240, under authority of Public Law 87-758, 76 Stat. 753, as a service to aquariums generally.

FROM THE EDITOR:

The price for your subscription to the D&C is material for each issue: short articles, news items on personnel and collection trips, unusual specimens or techniques at your establishment.

We offered single copies of the art work on the front and back covers of the May issue. In view of the response, we are including herein one of each suitable for framing, and have also enclosed a single copy of the drawings on the back cover of this issue.



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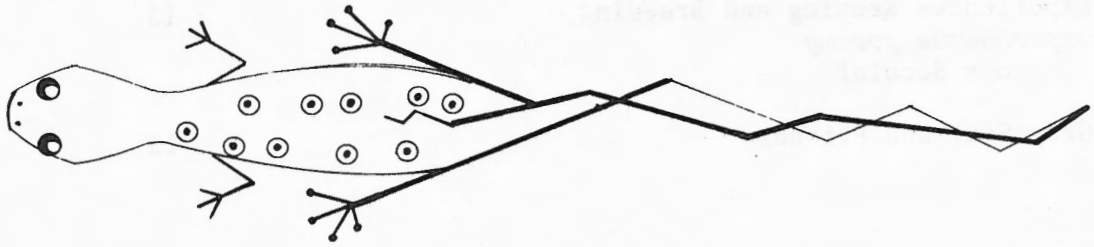


Report on the Aquarium Symposium at the Ann Arbor Meeting of the American Society of Ichthyologists and Herpetologists

June 16, 1968

As a pre-convention warm-up, the Shedd Aquarium on June 15, at Chicago, provided supplies for a happiness hour and dinner for about 30 visiting aquarists.

The Aquarium Committee met on June 16, at Ann Arbor. The results of this meeting are not known.

The Symposium sessions at Ann Arbor on June 17, were fairly well attended. From 25 to 75 interested persons were present for presentations of papers. Inasmuch as I & H sessions were held at the same time, the attendance was down from last year.

Although we had requested abstracts from all those who were on the program, we have received only those abstracts appearing on the following pages.

The American Museum, New York, will be host to the June 1969 ASIH meeting with Jim Atz as Chairman. The place of the Aquarium Symposium will be announced later. Reserve some of your budget for attendance.

CHRONIC EFFECTS OF HEAVY METALS ON FISHES

John G. Eaton
Research Aquatic Biologist
Federal Water Pollution Control Administration
Cincinnati

ABSTRACT

Fathead minnows (*Pimephales promelas*, Rafinesque) have been continously exposed over one entire life cycle to several concentrations of each of the metals, nickel (Ni^{++}), chromium (Cr^{6+}), cadmium (Cd^{++}), and copper (Cu^{++}). In addition, a chronic exposure has been run using a mixture of Cu^{++}, Cd^{++}, and Zn^{++} as the toxicant; and Cu^{++} has been tested in both hard and soft water.

The effects recorded were those rendering the experimental fish different from control fish in their readily observable life responses, including their reproductive capacity. All exposures began with young, post-fry stage fish. The effects observed at the lowest concentrations producing such changes were:

1. Significant mortality prior to spawning (Cd^{++}, Cr^{6+}, and Cu^{++} in soft water);
2. No egg production (Cu^{++} in hard and soft water); and
3. Reduced egg production (Zn^{++}, Ni^{++}, and the three metal mixture).

Of these metals, Cu^{++} in soft water was the most toxic and Cr^{6+} the least toxic.

Research now underway involves examining the effects of some of these metals on other species of fish, and experimentally polluting a small natural stream with Cu.

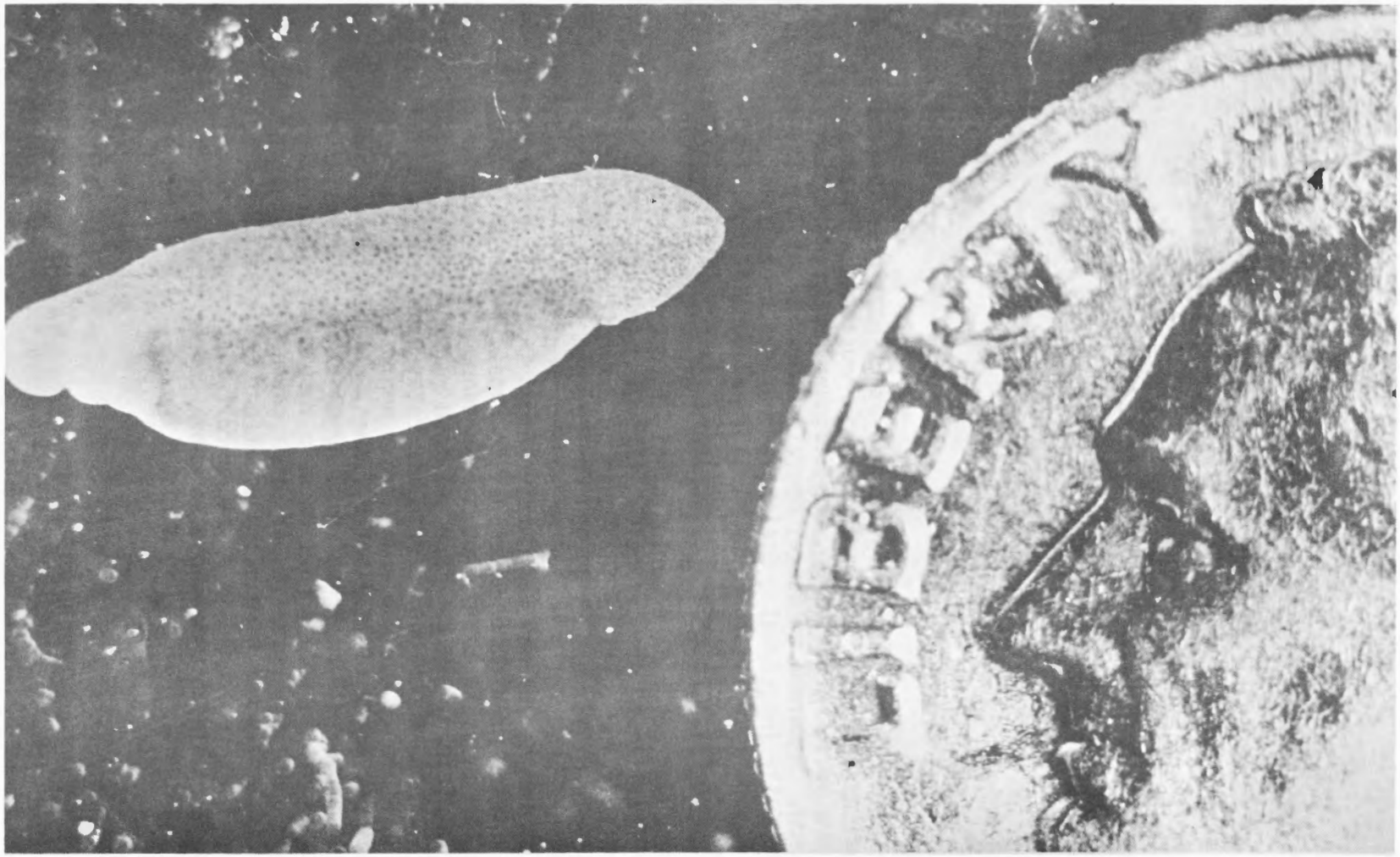
ULTRAVIOLET STERILIZATION OF AQUARIUM WATER

Earl S. Herald, Robert P. Dempster and Marjorie Hunt
Steinhart Aquarium
San Francisco

ABSTRACT

Three large ultraviolet sterilizing systems have been installed in American aquariums and oceanariums: Aquarama in Philadelphia, Sea World in San Diego, and Steinhart Aquarium in San Francisco. Aquarama no longer operates theirs, but the latter two are fully functional. Steinhart operates sterilizers on three systems: alligator tank (11,132 gallons; 82°F.), tropical marine fishes (21,635 gallons; 75°F.), and tropical freshwater fishes (27,463 gallons; 82°F.). Intermittent bacteriological tests covering a period of eight years have shown that the UV sterilizers are effective in keeping the bacterial population at a low level of less than 50 per cc compared with high levels of as much as 40,000 per cc when the sterilizers are not operated for a period of several months. In the alligator system the UV has definitely helped in limiting the constant surgery previously necessary to repair wounded 'gators. The mayhem is still there, but the subsequent infections are now at a minimum. In the tropical fish water systems the effects are not so obvious. Mortality rates with the UV operating have been about the same, i.e., approximately 2 1/2 per cent per month of acclimated fishes. Fishes can and do live in waters with high bacterial populations; however, when the fishes are in poor condition as a result of malnutrition, improper handling, parasites or other causes, then the high bacterial levels may have a lethal effect. Ultraviolet sterilization is recommended as a safeguard for aquarium systems housing valuable animals and also where copper or chlorine cannot be used.

END



Young Australian lungfish (approx. 2 cm.) beside a ten-cent coin. Photograph by Tom Prusha, Cleveland Plain Dealer. (Not to be reproduced without permission.)

SOME OBSERVATIONS ON THE SPAWNING BEHAVIOR OF THE AUSTRALIAN LUNGFISH, *Neoceratodus forsteri*

Daniel H. Moreno, Director
and
Richard Segedi, Curator
The Cleveland Aquarium

ABSTRACT

The morning of January 26, 1968 the Australian Lungfish on exhibit at the Cleveland Aquarium spawned.

During the entire process male and female were head-down in a corner of the 500-gallon tank, with the male's body partially entwined about that of the female.

In this manner all 200-odd eggs were deposited. The male discharged milt at irregular intervals during the process--not in synchronization with the female's egg-laying.

The eggs measured approximately 3 mm in diameter, and the non-adhesive, gelatinous envelope averaged about 2 mm in thickness. Except for a few which escaped our nets and dip-tubes, all eggs were removed to shallow trays for observation.

On and about the tenth day six eggs hatched in the trays, and a seventh hatchling was seen in the tank with the parents.

The young strongly resembled salamander larvae, and measured nearly 1 cm in length.

They were then transferred to three, 33 to 55 gallon tanks, where they doubled their length by the forty-fourth day after hatching.

They were fed brine shrimp nauplii, *(Artemia salina)* live and frozen, and had various species of algae available at all times.

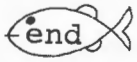
Days later all seven began becoming emaciated, and by the fifty-fourth day after hatching the last one died--cause unknown.

THE EFFECT OF FISH LOADING RATES ON THE ACCUMULATION OF AMMONIA, NITRITES AND NITRATES IN RECIRCULATING FRESHWATER AQUARIUM SYSTEMS

John Leonard
National Fisheries Center and Aquarium
Washington, D. C.

ABSTRACT

Forty-eight tanks, each with a capacity of 22 gallons and a biological filter of 20 pounds, were filled with varying quantities and weights of goldfish. Equal numbers of tanks were loaded with 11 fish weighing 60 grams, 22 fish weighing 120 grams, 33 fish weighing 180 grams and 44 fish weighing 240 grams. Weekly measurements on the tanks included ammonia, nitrite, nitrate, pH, dissolved oxygen and water temperature. The ammonia, nitrite and nitrate analyses were performed on the Technicon AutoAnalyzer and reported as ppm nitrogen. The pH was measured on the Beckman Expandomatic pH meter and the dissolved oxygen and water temperature were read using the Y.S.I. Model #51 oxygen meter. Significantly higher concentrations of ammonia and nitrite were found in the tanks loaded with 180 and 240 grams of goldfish. The dissolved oxygen content of the tank was significantly lower for each of the more heavily loaded tanks. The aquariums with 180 and 240 grams of fish had significantly lower pH values than the more lightly loaded tanks. Only in the method employed to measure the nitrate-nitrogen was the accuracy insufficient to permit statistical analyses of the experimental data.



THE PACIFIC OCTOPUS IN A CLOSED CIRCULATING ARTIFICIAL SEA WATER SYSTEM

Stephen H. Spotte
General Curator
Aquarium of Niagara Falls, Inc.

ABSTRACT

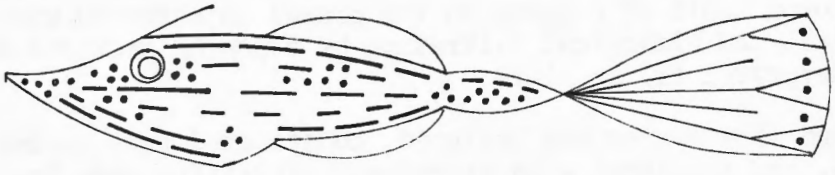
At Aquarium of Niagara Falls, *Octopus apollyon* had been maintained in a regular refrigerated 1000-gallon system. Maximum longevity had been 9 months. Problems were: low turnover rate which resulted in chronic ammonia levels (averaged 12 ppm), and low pH (average 7.7); undissolved air in the tank; fluctuating temperature due to improper insulation; insufficient mechanical filtration to remove discarded suckers and other detritus from circulation. Also, the tank was designed with walls sloping away from the front glass at 45 degree angles. The animal was out of the viewing area when resting on one of these walls. The octopus habit of digging in the gravel interferred with mechanical and biological filtration by exposing sections of the undergravel filter plate.

A 4-stage flow system was designed, constructed from marine plywood, and insulated with styrofoam. Air-lifts were increased from 1-inch to 2-inch which quadruples the theoretical carrying capacities of the lines. Water moves from the exhibit portion into the first filter by means of a surface-skimming spillway to remove floating detritus. It is simultaneously air-lifted through two 2-inch drains into the first filter. The exhibit portion is substantially smaller than the original system (300 vs 1000-gallons) to keep the octopus continually on view. It contains no gravel, and all three walls and the floor are covered with fabricated fiberglass "rock."

From the first filter, water moves by two 2-inch air-lifts into a second smaller filter. Here it is recycled once by two 2-inch air-lifts operating at full capacity to facilitate buffering. Next, it moves by gravity flow (positive head pressure) into a narrow chamber between the second filter and the back of the exhibit portion. From this chamber it flows over a spillway into the exhibit, eliminating surface agitation and undissolved air. Both filters contain 2-5 mm crushed dolomite. Total gallonage of the system is 800.

Comment added September 1, 1968: The system is in operation and appears to be achieving the objectives. However, results cannot be expected for many months. When available, these will be reported in Drum and Croaker.

This above is the last of the abstracts of papers presented at the Aquarium Symposium.



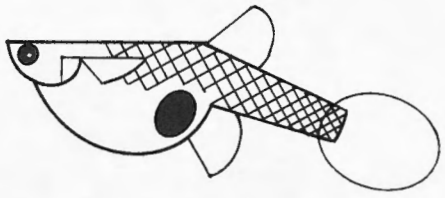
WAIKIKI AQUARIUM ANALYSIS

Spencer Tinker, Director of the Waikiki Aquarium, has prepared a comprehensive "Program Evaluation of the Waikiki Aquarium." This interesting 30-page effort covers the legal basis, history, purposes, organization, and activities of the aquarium in considerable detail and makes recommendations for the future.

THROMBOSIS OF THE AORTA IN A SMALL AQUARIUM FISH

By

Sylvan Cohen, M.D.
Canoga Park, California



While many of my most interesting specimens come from John Prescott at Marineland of the Pacific, occasionally a private hobbyist submits one of unusual interest which is worth reporting. Such a fish was an adult guppy (*Poecilia reticulata*) brought in one morning by a surgeon[1] who had noticed the fish swimming abnormally for the preceeding few days with her tail and the caudal half of her body held immobile. She had just developed a mottled, fuzzy appearance over this same area when she was brought to me and placed in formalin. The surgeon informed me that he believed the fish had thrombosed her aorta and infarcted the caudal part of her body. I was quite skeptical since I was not familiar with any primary vascular disease of fish, although this particular syndrome is not rare in humans.

After fixation and decalcification in Bouin's solution, microscopic slides were made of multiple cross sections of the guppy, and she had indeed thrombosed her dorsal aorta and infarcted her tail. The vascular occlusion became progressively more severe, beginning gradually near the

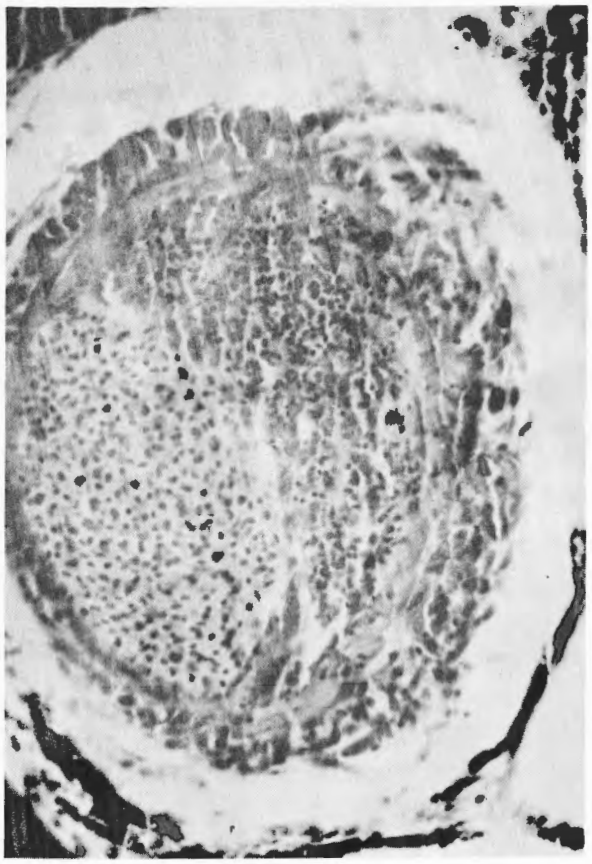
(100X) Anterior segment of dorsal body wall showing spinal cord, vertebral body and particularly occluded aorta.

anterior end of the dorsal aorta and becoming complete near the posterior end of the peritoneal cavity. The organs and tissues adjacent to the partially occluded vessel appear to be intact, while the posterior tissues show changes consistent with recent infarction. The aortic wall itself does not appear to be thickened or inflammed in the non-thrombosed segment, and no other vessels show obvious sclerosis. No internal diseases were found which could have contributed to the vascular occlusion, although the fish did have a few gill flukes (consistent with *Dactylogyrus* sp.) without serious gill damage.

Before becoming ill, the fish had been maintained in a seventeen-gallon aquarium with one male guppy and had been fed with a good quality dried food (Tetramin Staple Food). She had not been injured or handled, and no contributing cause for her illness could be found.

I have been unable to find any recent references to primary vascular disease in fish and do not know of any metabolic disorders which might contribute to spontaneous thrombosis of major vessels.

(100X) Posterior segment of dorsal body wall showing completely occluded aorta in center with adjacent degenerating muscle fibers.



(450X) Higher power view of partially occluded aorta showing residual lumen and adjacent mural thrombus merging with aortic wall.

(450X) Attached gill fluke *(Dactylogyrus* sp.?) showing two large tail hooks.

Shortly after this fish was examined, a platy *(Xiphophorus maculatus)* was submitted by a different hobbyist. The behavior and appearance of the platy was similar to that of the guppy. However, sections revealed not only thrombosis of the aorta, but granulomatous disease extensively involving many internal organs and impinging on the aorta, presumably contributing to the thrombosis and occlusion. No specific organism could be identified in the sections and cultures had not been taken.

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[1]The author would like to thank Phillip S. Ryan, M.D., for the specimen and his clinical diagnosis.

END

EXPERIENCES KEEPING AND BREEDING *Osphronemus goramy* (1)

Ross Socolof
Ross Socolof Farms
Palmetto, Florida

Osphronemus was named in 1802 by the French ichthyologist Lacepede. By this date the fish had a wide distribution. It is thought to have originated in the Indonesian Islands (Sumatra, Java, Borneo, etc.) and to have been distributed physically by man. By 1802 the fish was to be found through most of the southeastern part of Asia where it was kept in ponds as well as distributed throughout the natural watercourses.

The genus *Osphronemus* has only one species and this is *goramy*. *Osphronemus goramy* is different from the other six genera of Anabantids as the first ray of its ventral fin is highly developed into a very long filament. The key is "articulated" as other anabantids have feelers (leeri, moonlight, etc.) but they are unarticulated. As this is a new fish to some and one that promises to be with us for a long time, I take the liberty of indicating the correct pronunciation of Os-phro-NEE-mus.

This is a very valuable food fish as it has all of the attributes necessary for economic production. Its size is ideal as a look at the size of five year old breeders show. They weigh in as follows:

Length:	20 inches and still growing
Breadth:	6 inches
App. Weight:	7 pounds

Feeding presents no problem as they are omnivorous and indiscriminate eaters. They consume quantities of soft vegetable matter and will help keep aquatic vegetation down in an outside pool.

In Thailand the fish is called Pla Raet. This describes an interesting development in *Osphronemus*. Older fish will develop a hump and Pla Raet translates to Rhinocerus fish which in a general way describes this phenomenon.

The fish has always interested me and some five years ago, after at least five years frustration, I was successful in bringing in the initial import. Most of the young fish (1 1/2") were sold immediately as they have a most attractive color pattern and a regal swimming motion, combined with a unique body shape.

The color at 1 1/2 inches is not as intense as it becomes when the fish reach 2 1/2 inches in length and longer. The five year old fish are beautiful but the colors are not as intense as when younger. This matter of color is most intriguing as the various descriptions (Innes, Smith, Brymer, Harvey, and Hems, Sterba, Schneider) are contradictory. Personally, I think the fish is most attractive when it is 2 1/2 to 6 inches in length. I hesitate to describe it and will leave the pleasure of that experience to the individual owners as a composite description of color from the existing sources would give us something like this:

"metallic green, reddish, brownish, bluish body with brown spots, dark stripes, blue throat and bluish fins."

Every authority I have checked, without exception, reports this fish to be a bubble nest builder. It isn't. Its nest building is unique and unfortunately not properly photographed as yet.

Five years have passed since 25 small specimens of *Osphronemus* were set aside for potential breeding stock. Every spring for five years the fish have been put outside in a large dirt pool and fed copious quantities of food. Each winter they have been taken inside and kept in large concrete vats. The original 25 have shrunk to 7 great hulking brutes through the attrition of disease and natural predators.

Their pool is reasonably clear and the grass grows down into the pond. The male fans out a depression in the sand immediately adjacent to the bank to a depth of at least 12 inches. The fish then pulls out grasses and other higher plants (that are growing at the edge of the pond). "Pulls out grasses, etc." is exactly what happens and this is no exaggeration. The vegetable material is then woven into a great dramatic nest. The nest when finished is fully 18 inches across and 6 to 8 inches in thickness. Even more remarkable is the fact that the nest is woven right into and including grasses growing on the bank. This, then, securely anchors the nest to the bank.

The nests were checked constantly and as soon as the spawning was completed and the floating eggs were seen, the entire nest and contents were removed from the pool by lifting it out intact. A large galvanized wash tub was slipped under the nest and lifted by two men. The total eggs produced is estimated to be between 2500 and 3000. The first spawning produced 2000 young and the second spawning, which had a great number of infertile eggs only produced 500 young. The eggs are the size of BB shot which is quite large in comparison to other Anabantids.

---

(1) Mr. Frank Goddard of Lakeland, Florida did the actual raising and breeding of these fish.

THE MASTER RESTS

Gaston Morin, Director, Quebec Aquarium, sent us this unusual photograph of grey seal "Oscar" resting peacefully on his two wide awake female companions. "Myrtle, do we dare wake him up?" or "A harem under subjugation," or you come up with a better title.

Miami Seaquarium's Killer Whale

Photograph by Bill Stephens

GUESS WHAT MOM?
NO CAVITIES!

MIAMI SEAQUARIUM
RECEIVES KILLER WHALE

On May 16, the Miami Seaquarium welcomed a two-year old male killer whale which was flown from Seattle in a Flying Tiger Line cargo plane. The flight took about eight hours, during which time the whale rode in a custom-made cradle lined with fleece where he was kept moist by Seaquarium staff members.

The whale was captured for the Seaquarium by Ted Griffen, Director of the Seattle Public Aquarium and is 12-1/2 feet long and weighs 1,800 pounds.

On June 18, Bill Stephens, Director, Educational Programs at the Seaquarium, reported:

> The whale is responding beautifully to training and both Jimmy Kline, his trainer, and Kline's assistant, Bill Petty, have been riding it for the past week. I rode the animal myself this past weekend and can report it was an exhilarating experience. The only problem is to maintain one's balance in the sharp turns the whale is forced to make in the small pool (the whale is temporarily kept in the circular 35-foot diameter pool that was built for Carolina Snowball). Construction will begin soon on a large special tank that will be 40 feet wide, from 100 to 120 feet long with a maximum depth of 22 feet. This will give the whale room for some of these resounding leaps and violent lob-tailing that often follow the close of a training session. He is very docile while he is being either stroked or fed, but acts like a frustrated child when everyone goes off and leaves him alone.

End

PHILADELPHIA UNDERWATER MUSEUM

In April the world's first Underwater Museum was opened at the Philadelphia Maritime Museum, of which Theodore C. Leydon is Director.

The Museum's collection of tools, artifacts, photographs, documents and models forms a unique history of man's activity underwater. Many strange and wonderful devices that fertile minds from the time of Aristotle, Alexander the Great and Leonardo da Vinci have produced; breathing devices designed in the fifteenth and sixteenth centuries; the actual equipment used by "frogmen" during the invasion of Normandy; today's popular compressed air lungs, the newest mixed gas and liquid air lungs; helmets and "hard hat" suits (changed only slightly in more than a century) and cumbersome armored suits.

The evolution of the submarine -- the Turtle used in the American Revolution, the Nautilus of Robert Fulton and the Nautilus of our modern nuclear Navy; Simon Lake's open hatch Argonaut, Jr. of 1894 and Edwin Link's open hatch Deep Diver of 1967.

Bathyscaphes and research submarines, vehicles like the Trieste I that took men to a record 35,800 feet, Alvin and Aluminaut which located and recovered Palomares H-bomb are all represented in models and pictures. Retired to the Museum is General Dynamic's first one-man observation submarine, Star I. Her newer sisters, Star II, Star III and Asherah are represented, as are early underwater boats, through nuclear submarines to Trieste and the latest lock-out and rescue vehicles. Also shown are the "houses" of the Oceanauts -- the home bases for the men who will live underwater drilling for oil, farming fish and mining the seas' riches.

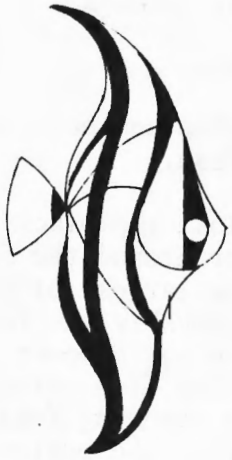
Man now has begun intensive exploration of his underwater world. To display, house, and record man's exploration of inner space is the mission of the new Underwater Museum. It provides a significant representation of man's attempts to learn about and conquer his least-understood atmosphere.

The Underwater Society of America has established its national headquarters at the Museum.

REPRODUCTION AND EARLY DEVELOPMENT

IN

*Monodactylus sebae**



Compiled by
Arthur M. Hegedus, Curator
Arthur C. Johnson Aquarium
Columbus Zoological Gardens

The period covered in this document is May 7, 1967 to December 20, 1967. On May 7, 1967, eggs were discovered floating in the filter boxes of a 70-gallon tank. Some were also noticed in the tank itself. Prior to this time, on April 27, the tank was noticed to have a rather milky color. This was attributed to overfeeding. This may well have been the reason, though later the possibility of a heavy milt discharge was considered.

Considerable time and effort were expended at this time in the preparation of eggs and fry for photography. The results were quite satisfactory. Several specimens were preserved at this time.

Line drawings of fry were rendered by Aquarium attendant James Dunkle with the aid of a 9X jeweler's lens and a microscope.

To the best of our knowledge, this is the second spawning of this species in captivity, and the only hatch. If there have been other hatches, we would appreciate any help or suggestions on the care of fry, since we can only proceed on past experiences with other species and even here we run into snags as these fish are in a unique family, all eluding being bred and reared in captivity. If there is available information, please forward to:

*Fingerfish

Arthur C. Johnson Aquarium
Columbus Zoological Gardens
Route #1
Powell, Ohio 43065

The following is a composite of the notes and observations accumulated during the care of these fish.

PARENTS--One fish of a tank of eight lost the black stripes and took on a pale yellow color around the fins and ventral surface. This fish was the largest of the group and was quite plump. This was probably the female breeder. Pinpointing the breeding male(s), however, proved impossible, since all of the other fish retained their vertical stripes. The tentative breeding female has kept the faded color to date. During the entire observation period, there has never been any sign of courtship or breeding behavior. Nor has there been any display of breeding apparatus in any of the fish.

It must be assumed from observations of more than ten spawnings that courtship and spawning occur under cover of darkness.

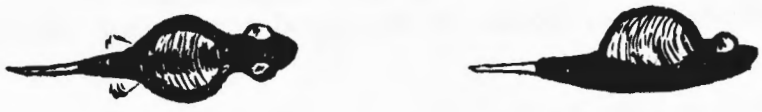
The sizes of the eight adults are:

Three largest -	Length	6 - 6 1/8"
	Height	7 - 7 3/4"
Five smallest -	Length	4 - 4 1/8"
	Height	5 - 5 1/2"

EGGS--It is quite possible that the initial spawning might have been overlooked had we not been using a dark filter medium in this tank. The eggs are extremely small for the size of the adults, and they are white to clear, making them all but invisible against a white medium. The eggs are approximately 1/32" in diameter, and are dropped in quantities of two to three thousand (assuming that this is a single breeding pair). They are round and white, floating when fresh. They tend to clear quickly when fertile and turn milky when infertile. They seem to become adhesive only when infertile.

FRY--The fry emerge from the eggs in approximately 24 hours after they are laid. They too, are extremely small, and as best we can ascertain, hatch at a ratio of about ten percent. Our first spawn resulted in about 250 fry.

They swim rather well, though jerkily as many small fry. The yok sac is carried on their backs and is absorbed in about sixty hours. Getting the fry much past this point has proved very difficult thus far.



Dorsal Lateral

Approximately 45 times natural size

FOOD--Adults: The adult fish are quite voracious and not at all choosy about eating. It is our policy here to feed them in the following manner:

Monday, Wednesday, Friday - Cooked spinach, hamburger
Tuesday, Thursday, Saturday - Frozen adult brine shrimp
Every morning and evening - Purina Trout Chow developer

Young: Over the months and through many spawns, a multitude of feeds have been tried on these tiny creatures, but thus far, it appears that the proper one has yet to be administered. It might be noted that there has always been an ample supply of animalcules available in both the parent and brood tanks (Cyclops, Planaria).

Subsequent foods tried were Fosterfry, green algae, infusoria, newly-hatched brine shrimp, and plankton from the Scioto River.

We have a few other methods to use, but would appreciate further suggestions from others.

LIGHTING--Sylvania Gro-Lux and Cool White lights have been used intermittently on both the parent and brood tanks. Hours of light have also been varied, again with no apparent results.

CARE--On the initial (and some subsequent) spawn, three 5-gallon tanks were used for brooding. In one, a solution of 4 ml. of Aqua-Aid was added; in a second, three drops of Methylene Blue per gallon; and in the third, nothing was added. No significance noted.

Water levels in the tanks were also varied in many spawns, from 2" to 9", and again, nothing to correlate.

WATER CONDITIONS--The parent tank is kept at a temperature of about 80° (26 - 27° C.) as are brood tanks. Some fluctuation was promoted in the brood tanks, but nothing noted.

The specific gravity is brought to about 1.003 by the addition of Rila Mix to the water.

The bottom of the tank is covered by medium pea gravel (1/4 to 1/2"), contains a few rather large rocks (limestone) and no plants.

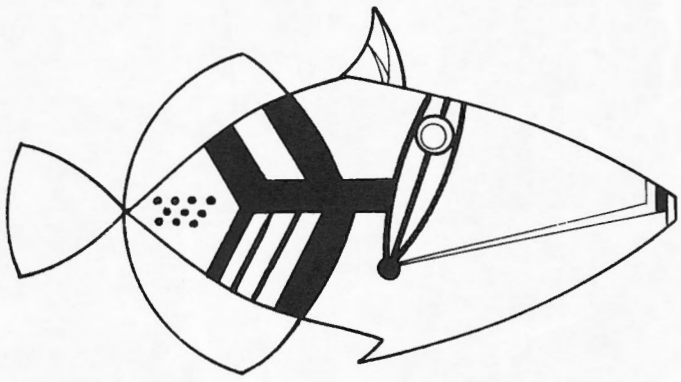
Water analysis was carried out with the use of a Hach Kit. Below is the average of two analyses. This is all as the water comes from our well, before any changes.

Temperature	14.4°	Centigrade
pH	7.65	
Oxygen	9.6	Parts per million
Carbon dioxide	0.0	ppm
Alkalinity	270.0	ppm
Chloride	35.0	ppm
Chromate	0.04	ppm
Copper	0.38	ppm
Fluoride	0.33	ppm

Hardness		
Calcium	228.5	ppm
Magnesium	96.5	ppm
Total	325.0	ppm
Iron	0.08	ppm
Manganese	0.83	ppm
Nitrate	14.0	ppm
Nitrite	0.012	ppm
Phosphate	0.51	ppm
Silica	11.88	ppm
Sulfate	210.0	ppm

CONCLUSIONS--It appears that the fry are not particularly sensitive to changes of lighting, temperatures, chemistry of water, or medication in small amounts. The proper food is evidently the most pressing of the missing links.

Our fish continue to spawn, though with much longer intervals, and more sparse in quantity and fertility. Perhaps this will continue long enough for us to find a way to rear these colorful and elegant fish.



SEA WORLD EXPERIMENTAL
SHARK TANK

EXPERIMENTAL TANK FOR PELAGIC SHARKS

David C. Powell
Curator of Fishes
Sea World, San Diego

In the past, this spectacular and widespread group of marine animals has never been satisfactorily maintained and displayed in captivity. Because of their potential as a public exhibit and the relatively sparse knowledge of their physiological needs during transport and in captivity, we at Sea World felt that a small, but hopefully adequate shark tank should first be constructed and put into operation. What we learn from this will guide us in the design of a public display complete with underwater viewing of large pelagic sharks such as the white shark, mako, blue shark, thresher, whitetip, blacktip, tiger, etc.

The tank has been in operation for five weeks and at the present time it contains six blue sharks (*Prionace glauca*). These are all feeding and acting well. The first specimen introduced to the tank was a great white shark (*Carcharadon carcharias*) that weighed 120 pounds (54kg). It appeared to act well for six days, but deteriorated rapidly and died on the seventh day. The loss of the white shark is believed to have been due to anoxia during the period of transport. Improvements in the transport technique have been made and success with a white shark is anticipated in the near future.

In the short period of operation, the tank and its water system seem to be functioning quite well and will be confirmed in the near future with the acquisition of additional species and specimens.

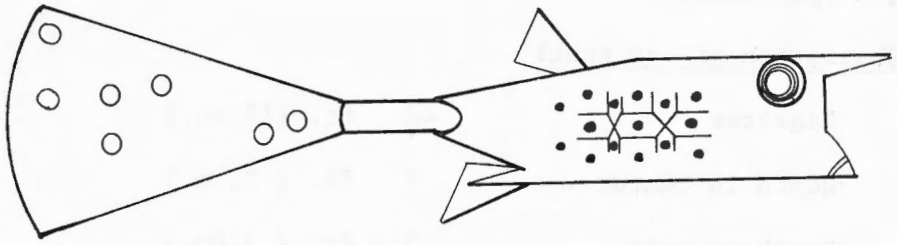
Statistics of the tank:

Diameter	48 ft. (17.5m.)
Depth in center	7 ft. (2.1m.)
Depth at edge	3.5 ft. (1.0m.)
Volume	65,000 gallons (247,000 l)
Pumping rate	450 gpm (1,700 liters per minute)
Filtration	hi-rate pressure sand filters
Aeration	75% of water flow is passed over a rock cascade prior to entering tank.

Chemical treatment -- Alum is added continuously prior to the filters at a rate of approximately 0.5 ppm. No copper sulfate is used. Algae and diatoms are controlled by the periodic addition of the algicide 2-chloro-4, 6-bis (ethalamino) s-triazine (brand name Algi-gon).

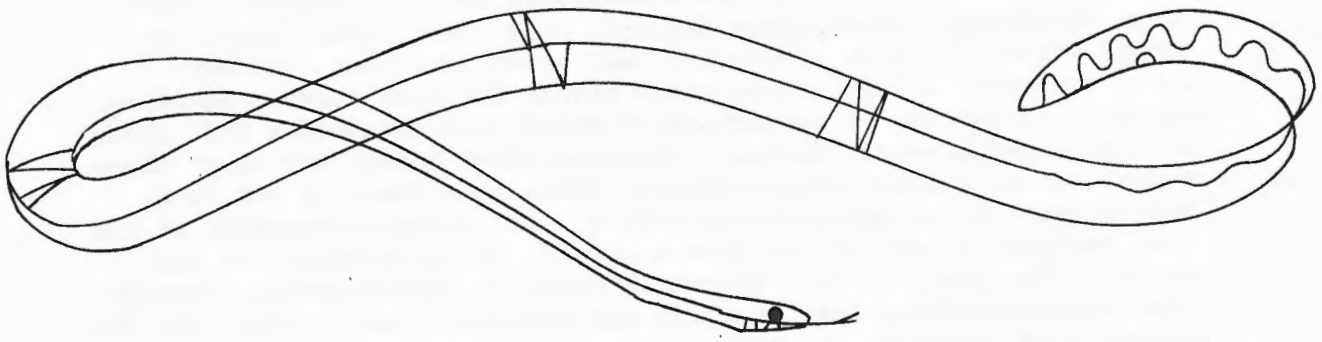
The concrete tank bottom is finished with a smooth epoxy finish and the sharks are protected from the hard concrete vertical wall by a smooth nylon reinforced vinyl curtain suspended from the overhanging walkway. In addition to occasionally banging the tank wall when turning around, the blue sharks often swim with their pectoral fins touching the side. To date, the plastic curtain has prevented any noticable damage to the skin of the sharks and we attribute a great deal of our success to this curtain.

Work is underway on a study of the oxygen consumption and minimum oxygen requirements of the blue and mako sharks. This information should contribute greatly to solving the rather haphazard transport methods that have been used in the past.



MAINTENANCE OF THE YELLOWBELLIED SEASNAKE, *Pelamis platurus*, IN CAPTIVITY

Warren Zeiller
Curator of Fishes
Miami Seaquarium



The family Hydrophidae, the true seasnakes, is closely allied to the family Elapidae that includes the venomous cobras, kraits, and coral snakes. The hydrophids appear to be the most difficult of aquatic snakes to keep in captivity, although *Pelamis platurus* appears to be a notable exception to this rule.

Thirty-six *P. platurus* were captured on May 8, 1967, near Isla del Rey, Islas Perlas, Gulfo de Panama. They were taken by Jon Staiger, Institute of Marine Science, University of Miami, on the JOHN ELLIOT PILLSBERRY cruise #P6703 under the direction of Gilbert L. Voss. Most of the specimens were preserved for future study with the exception of two which Staiger thoughtfully returned alive to Miami Seaquarium. These arrived in separate gallon jars with perforated tops on May 25, 1967, the date from which the following records commence.

Both *P. platurus* were placed in a single 60-gallon 18" x 20" x 36" closed system laboratory aquarium, filled only halfway (to frustrate escape attempts) with water from Biscayne Bay (salinity: 36 0/00). A plastic mesh screen top was placed over the aquarium to prevent their being molested or handled. Filtration was by a commercial air-lift unit suitable for an aquarium of 60-gallon capacity. The filter media were glasswool and granular charcoal.

Craig Phillips had speculated that *P. platurus* might survive in an out-of-doors pool or in a tank exposed to sunlight or ultraviolet light, because they spend long periods of time resting at the surface. His insight into this problem was in line with our own work in ultraviolet irradiation of marine aquaria. A single 48-inch F40BL long wave ultraviolet, flourescent tube was placed diagonally across the top of the aquarium. This illuminated the tank for eight hours daily.

The specimens were designated S (with a yellow diamond mark on the head) and F (top of head entirely black). F substantially heavier of body than S, appeared the healthier of the pair.

It is known that *P. platurus* consume live fishes. A low concentration of marine species seemed to avoid capture with ease. With a dense school, the snakes probably would have been more successful. Fresh water swordtails (*Xiphophorus helleri*) were tried next. These succumbed within 15 to 30 minutes to salt water immersion, and were taken with ease by the snakes while barely alive or freshly deceased. On their second day at Seaquarium, S and F each consumed a half dozen of the 1-to-1 1/4-inch fishes. This continued throughout their lives, except during periods of shedding at which time they did not feed. Feeding was always accomplished with a rapid sideways movement of the head and part or all of the body according to the strength of the thrust. The fish was held broadside until it ceased moving; then the jaws manipulated the fish until it was swallowed head first. The distended area caused by the fish within the gut was obvious as it progressed posteriorly. Both specimens fed while water temperatures were 78 degrees F or above. Below that, they became lethargic. When the water temperature dropped due to lower winter ambient temperatures, a standard aquarium heater was utilized to maintain a steady 80 degrees F environment.

S and F seemed healthy. Each shed fifteen times during their year in captivity. The time between sheds ranged from 9 to 43 days. Three times the shedding process of S took periods of 16, 12, and 6 days. Those of F were always overnight, fast and clean. F died (April 24, 1968) four days after its last shed, and S died (June 4, 1968) while still in the process. (See Table 1.)

The *P. platurus* were handled as little as possible. When they were, several times for filming, once to be measured, and once to be moved from isolation to brief public display; they were treated with respect as there is no available antivenom. In September, 1967, both were measured, somewhat inaccurately because it is impossible to stretch them to full length without strenuous effort and resultant injury to the snakes. S measured 22 inches and F was 22 1/4 inches at that time. Each was measured again upon its demise; their measurements were exactly as before.

In March, 1968, the snakes were moved from the relative isolation of the laboratory to a new 90-gallon capacity public display aquarium. As before, the aquarium was filled halfway and a screen top was installed. The new aquarium is illuminated solely by natural sunlight which penetrates a U.V. transmitting plexi-glass weather guard. They were fed as before. From then on the snakes apparently began to decline in health. Whether or not they were already declining prior to being moved is subject to conjecture. It can only be said that all appeared as normal as before to this point. There is evidence that lack of a long wave light source (F40BL or equivalent) over the new installation was a causative factor. Acquisition of new specimens and additional investigations are required.

The year during which the two *Pelamis platurus* were maintained in captivity was sufficient to demonstrate the feasibility of duplicating and refining methods outlined above. This will enable students to study *P. platurus* and, possibly, related forms. Commercial establishments such as Miami Serpentarium should be able to maintain them long enough to formulate antivenom which at present is nonexistant in this hemisphere. The value of these beautiful and interesting creatures to stimulate aesthetic senses of zoo and aquarium visitors cannot be overlooked, as well.

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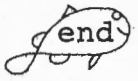
TABLE 1

SHED TIME IN DAYS AFTER RECEIPT - 25 May 1967

S		F	
Resting	Shedding	Resting	Shedding
22	1	3	1
11	3	22	1
11	1	9	1
9	1	10	1
10	16	21	1
12	12	13	1
9	1	12	1
32	1	27	1
26	1	22	1
29	1	10	1
39	1	43	1
16	1	34	1
30	1	26	1
40	1	33	1
32	6 (Died)	40	4 (Died)

Resting - time between sheds: Shedding - duration of shed



NOTE: It is recommended that all A.R.S.E. personnel keep in mind the following standards when invited to participate in the judging of amateur tropical fish shows. -- Editor

RECOMMENDED STANDARDS FOR TANK FURNISHINGS OTHER THAN FISHES AND PLANTS

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

2. Frogs. Bubbles ejected from the mouth of ornamental frogs should be spherical, one inch in diameter, and released at regular intervals of 30 seconds. Bubbles passing out from the other end will be disqualified. The frog is to be highly colored and of no known species.

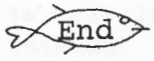
3. Sunken galleons must be small enough to look ridiculous when compared with the accompanying fishes, and must not be shown in marine tanks where they might appear more logical. It is recommended that they be placed poop over sprit. The captain must always be visible, as a ship which sinks without its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

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

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

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

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



RAINBOW EGGS RESIST BIG BUMP

In December 1967 the Manchester National Fish Hatchery in Iowa shipped 200,000 rainbow trout eggs to the Crawford National Fish Hatchery in Nebraska. Weather conditions caused this shipment to be delayed in Denver, Colorado, but finally the eggs were placed on board an outgoing flight. Unfortunately, the plane crashed and several members of the crew died. The eggs, however, survived both 4 1/2 days in transit and the plane crash. They hatched at Crawford and are now doing well.

THE PROGRESSIVE FISH-CULTURIST April 1968

MARINE WORLD, a subsidiary of American Broadcasting Companies, Inc., located on 86 acres of San Francisco Bay shore at Redwood City, opened in July. Included in the first 60 acres as the initial phase is a seven-tank exhibit displaying several thousand specimens of salt water life, an open-air theater for performances by whales, dolphins and seals, an ichthyarium with biological lectures, a seal cove, a sea bird sanctuary, a stadium fronting on a hugh lagoon that is the course for water skiing entertainment and competitions and the first of a series of living replicas of water-based communities throughout the world. The complex is built on a group of four islands and four keys laced by channels and connected by bridges. Shops, restaurants and boat touring facilities for the entire area are included in this first phase.

SHEDD AQUARIUM is preparing a special exhibition of Illinois fishes and other aquatic animals for the Sesqui-Centennial celebration.

Shedd reports attendance up 22% over the same period of 1967.

WILLIAM M. STEPHENS, writer and marine naturalist who has explored Florida water for 15 years, has been appointed to the post of director of educational programs and public information officer at the Miami Seaquarium, Burton Clark, general manager of the Seaquarium, announced.

THE CURSE OF COPPER-BEARING MINERALS IN AQUARIUM SAND AND GRAVEL

Robert P. Dempster and Earl S. Herald
Steinhart Aquarium
California Academy of Sciences

and

William H. Shipman
U.S. Radiological Naval Defense Laboratory
Hunters Point, San Francisco

The title of this report could well have been "The Great Copper Mystery." At Steinhart Aquarium a number of tropical freshwater fish were found dead from what proved to be copper poisoning. They were living in a 32,000-gallon water system constructed of supposedly inert materials. After a long and baffling search for the cause of the catastrophe, conclusive tests showed the presence of deadly copper ions in this water system. The strange story explaining the source of this insidious copper invasion will undoubtedly prove to be one of the classics of the Aquarium world.

During the winter and spring months the freshwater supply from the San Francisco Bay area reservoirs is usually quite turbid because of a high content of clay held in colloidal suspension. Consequently, it is highly undesirable to add water from these reservoirs to the freshwater systems during this time of the year.

One morning after several months without additional water having been added to the warm (82°) freshwater circulating system 10 large tinfoil barbs *(Barbus schwanenfeldi)* (See Fig. 1) were found dead in one of the tanks. The dead fish were examined carefully, but no apparent cause of death could be immediately determined. Shortly after the dead fish were discovered, it was noticed that several other barbs in this same tank were showing signs of distress. Upon observing barbs of the same species in a distant tank in the same water system, it was found that they were also in distress. Since other fishes in that water system were not exhibiting symptoms of discomfort, it appeared rather obvious that there was something toxic in the entire water system that was affecting only the barbs.

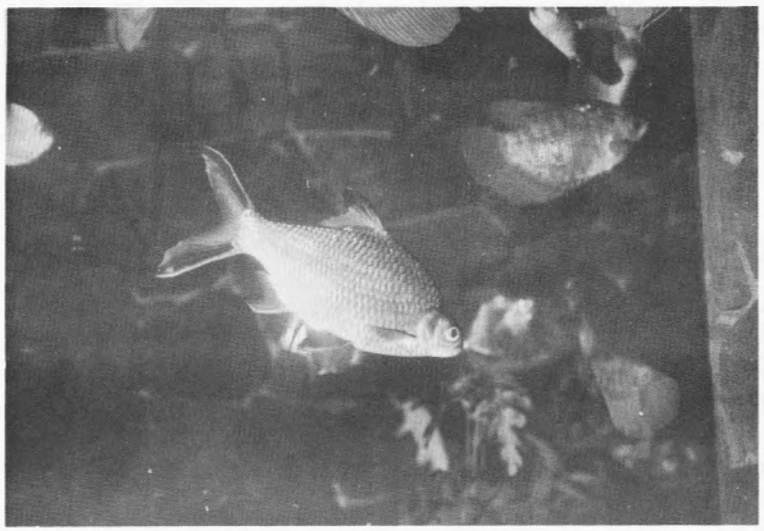


Fig. 1 A Tinfoil Barb *(Barbus schwanenfeldi)* living in a tank with other fishes in copper-free water.

Water analysis, including the usual pH, oxygen, and copper tests were made. All tests proved the water to be normal for fish tolerance except that for copper concentration which was 0.09 ppm as compared to a normal of 0.03 ppm or less. This concentration of copper, even though it seemed to represent an insignificant figure, was toxic to the barbs. The only practical method of reducing the concentration of copper in the water system was to dilute it with fresh water. Consequently, 10,000 gallons of water were dumped and an equal amount of the cloudy water from the reservoir was added to the system. The addition of cloudy water gave the display tanks a very unpleasant appearance and, to make matters worse, within the week, even before the filters had sufficient time to clarify the water, the copper level again began to climb and the barbs were again in trouble.

All Aquarium personnel immediately began a painstaking search to discover the source of this insidious fish poison. It was only after all possible sources of copper contamination had seemingly been exhausted that a sample of sand was collected from one of the filters and tested chemically. The sample was extracted with the sodium salt of EDTA (ethylenediamine-tetraacetic acid) and found to contain copper, and to be rich in iron in the form of hematite (Fe_2O_3). A sample of gravel was also collected from the bottom of the barb tank, and it too was found to contain copper. In this instance the copper was associated with magnetite (Fe_3O_4), another iron ore. (See fig. 2)

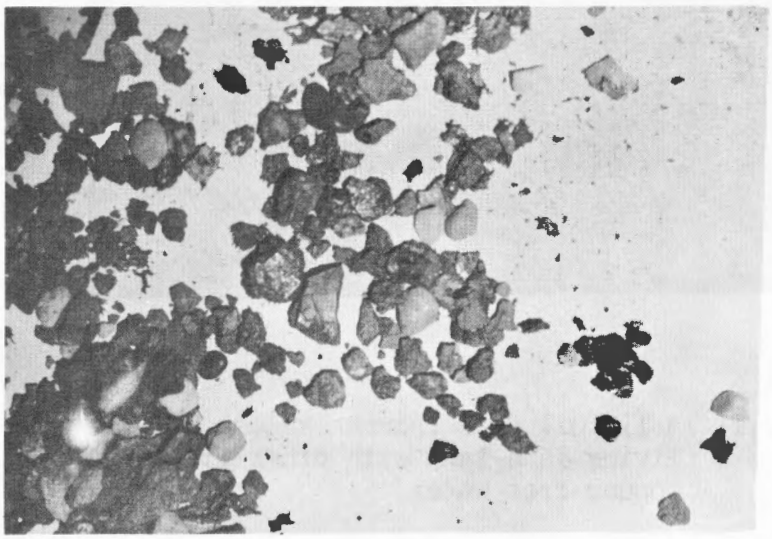


Fig. 2 Magnetite removed from one of the display tanks in the tropical fresh-water system at Steinhart Aquarium.

As a result of these findings it looked as though the most likely source of copper in this water system was the filter sand and the gravel in the display tanks. In order to remove the magnetite from this water system, a large and very strong magnet was dragged through the gravel in all of the display tanks. A substantial amount of magnetite was removed by this procedure. (See Fig. 3) To our amazement the magnetite represented about 7% of the gravel in the barb tank. In addition the filters were thoroughly backwashed with fresh-water and a solution of EDTA[1], at a concentration of 1 part in 240 was pumped through the filters for a 6-hour period. After removing the magnetite from the tanks and cleaning the filters, the entire water system was renewed with fresh water. This treatment substantially reduced the copper concentration, and even though a minimum amount of fresh water, about 5,000 gallons a week, was added to this water system over a 6-month period, the copper concentration remained below 0.03 ppm. Previously, it would have been 0.09 ppm or perhaps greater.

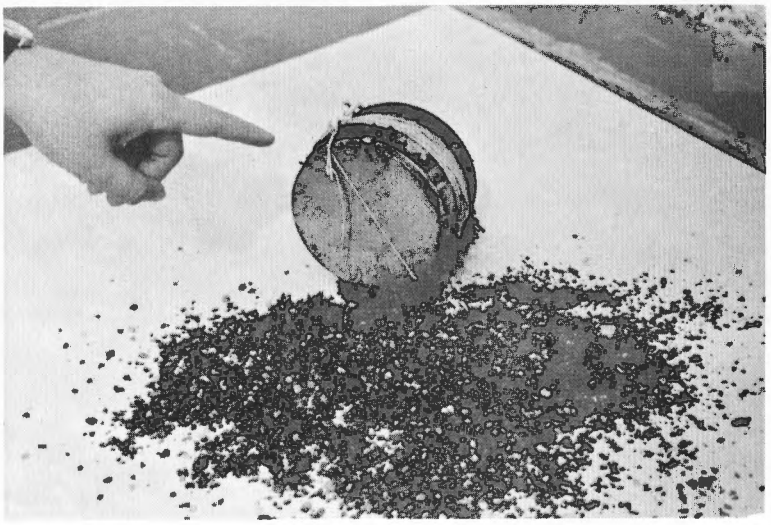


Fig. 3 A powerful magnet used to remove magnetite from the aquarium tanks.

[1]Made available through the generosity of the Klix Chemical Co.
EDTA = Disodium Ethelenedinitrotetraacetate

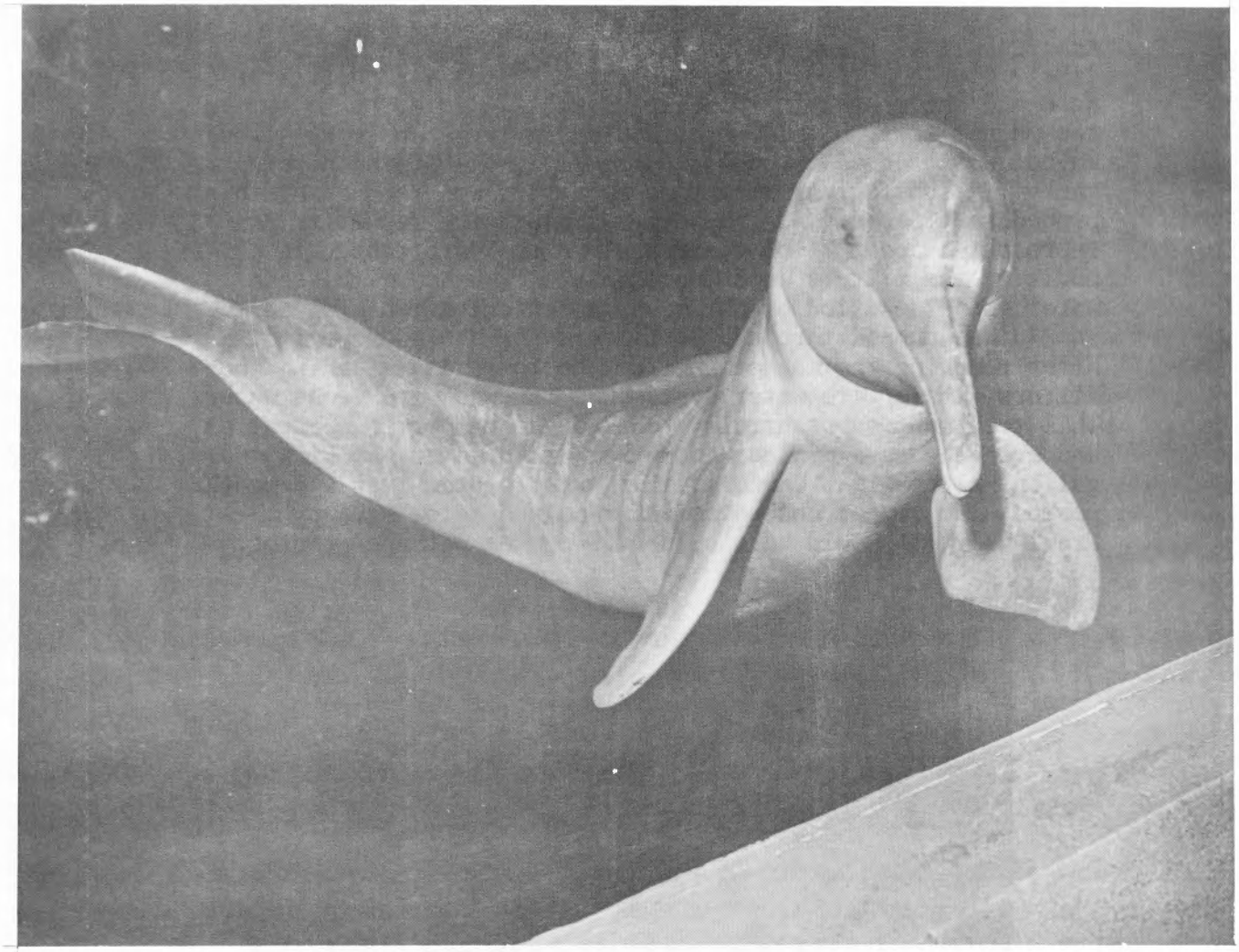


Fig. 4 Amazon dolphin *(Inia geoffrensis)*

* * * *

Having located the source of the copper, the unresolved question was: "Why had this copper buildup taken place now, but had not been significant during the previous three years that this heated freshwater system had been in operation?" As indicated earlier, this warm water system contains 32,000 gallons and normally has a population of about 650 fishes weighing approximately 800 pounds; daily food intake for this group is about 14 3/4 pounds. Based on fishes alone, this is a ratio of 0.40 ounces of fish to each gallon of water, which is a respectable balance.

Only one major change among the animal population in this water system had taken place during the previous three-year period. This was the addition of two dolphins from the Amazon. (See Fig. 4) The total weight of the dolphins at the time of the death of the barbs was 240 pounds, and their combined daily food intake was 20 pounds. Their estimated urea output for 24 hours would be approximately 10.6 pints (5,000 cc or 5 liters)--based on information from other species of dolphins. We believe that this volume of urea and the resultant amine production were sufficient to bring the copper into solution and cause the death of the tinfoil barbs.

As a result of these findings, Steinhart Aquarium is very careful to select sand and gravel for the filters and tank displays that are devoid of magnetite and hematite[2]. The presence of small quantities of magnetite and hematite in a water system is not troublesome to fish; however, a change in the chemistry of the water caused by the accumulation of large amounts of organic waste products is likely to increase their solubility and result in the release of a sufficient amount of copper and iron in the water to cause distress among certain fishes.

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[2] Unbeknownst to the writers, other professional aquarists had become concerned about the necessity of having magnetite free sand and gravel for aquarium tanks. Jonco Manufacturing Company, 1655 West Winton Street, Hayward, California, recently marketed a product, Wonder Rock, guaranteed to be free of magnetite. This material is now used in all large Steinhart tanks.

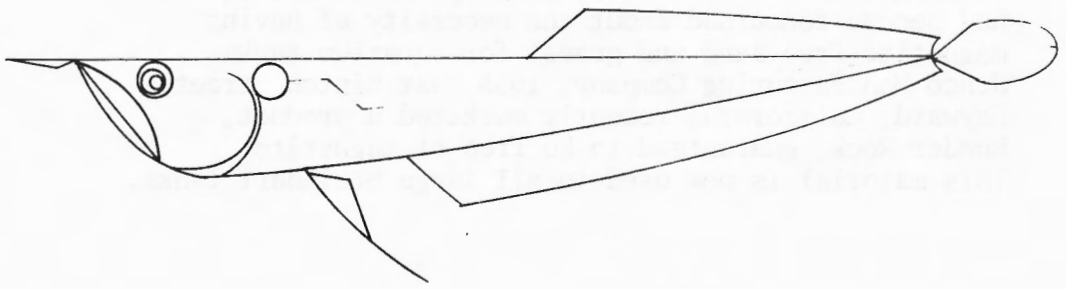
AQUARIUM FACILITY TO BE BUILT ON PUGET SOUND

The Oceanographic Commission of Washington State has appointed a committee to select a site and carry out the design, construction, and operation of a major aquarium facility on Puget Sound in King County. The new committee began work on May 7.

The sum of $3,000,000 in county general obligation bonding authority is available for the proposed aquarium. The County of King will contract with the Oceanographic Commission of Washington (OCW) and its State non-profit corporation, the Oceanographic Institute of Washington, to build and operate the facility.

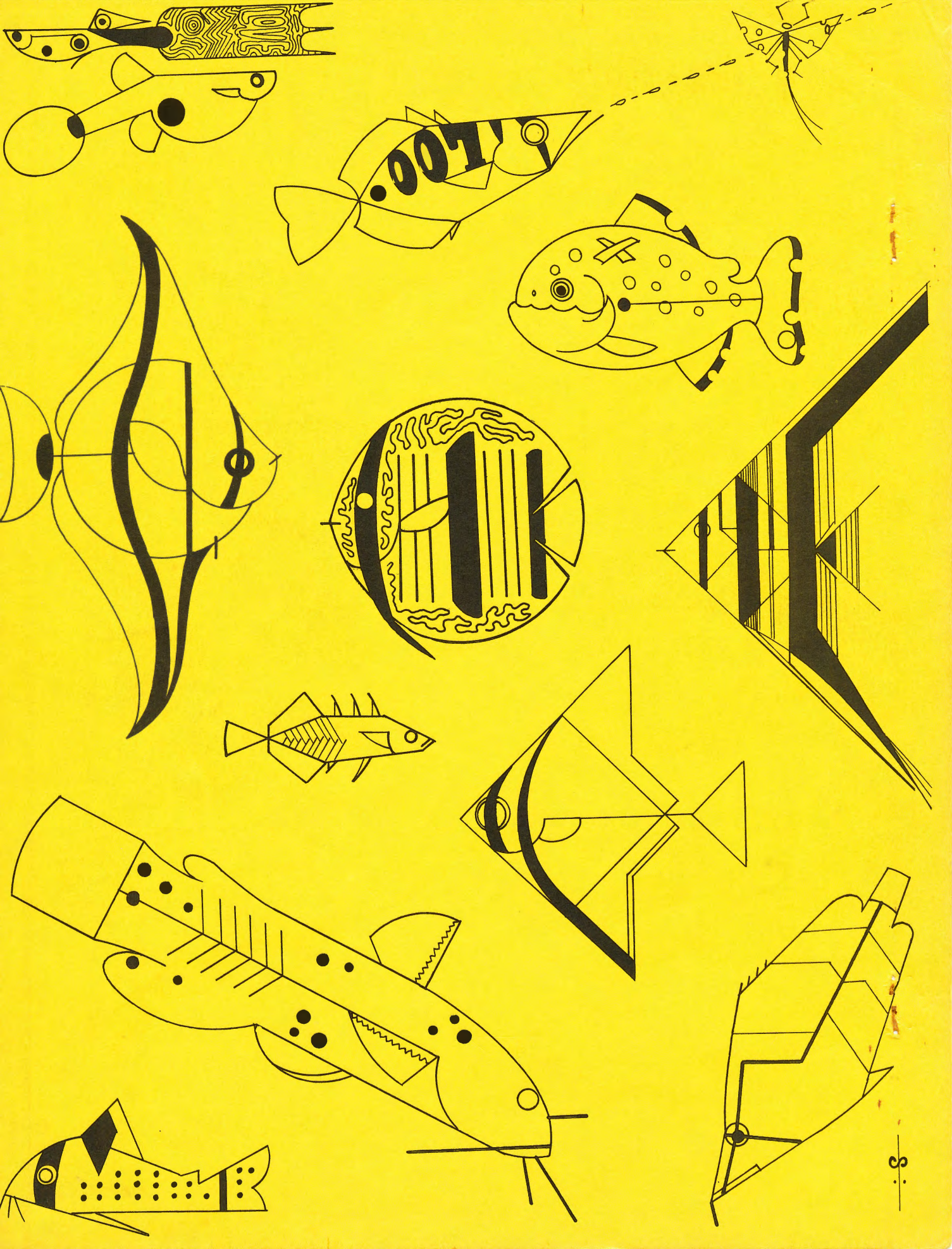
OCW members say that the proposed aquarium will be a modern mixture of public fisheries and oceanographic research facilities, many open to the public--and a working tool of all State educational levels from secondary to university.

The committee has representatives of the Oceanographic Commission of Washington, University of Washington, State of Washington Departments of Fisheries, Fish and Game and Parks and Recreation, the City of Seattle, King County, U.S. Bureau of Commercial Fisheries, the Pacific Science Center, and Virginia Mason Research Center.



MIAMI SEAQUARIUM CAPTURES SECOND WHITE DOLPHIN

An albino bottlenosed dolphin (sex unannounced at time of this writing) was captured near St. Helena Sound, Beaufort, South Carolina, by a collecting crew headed by Captain Emil Hanson of the Miami Seaquarium. This specimen may possibly be a relative of the famed "Carolina Snowball," a female white dolphin taken by the Seaquarium crew near the same spot in 1962. The new specimen was flown from Beaufort to Miami in a chartered plane on August 19.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