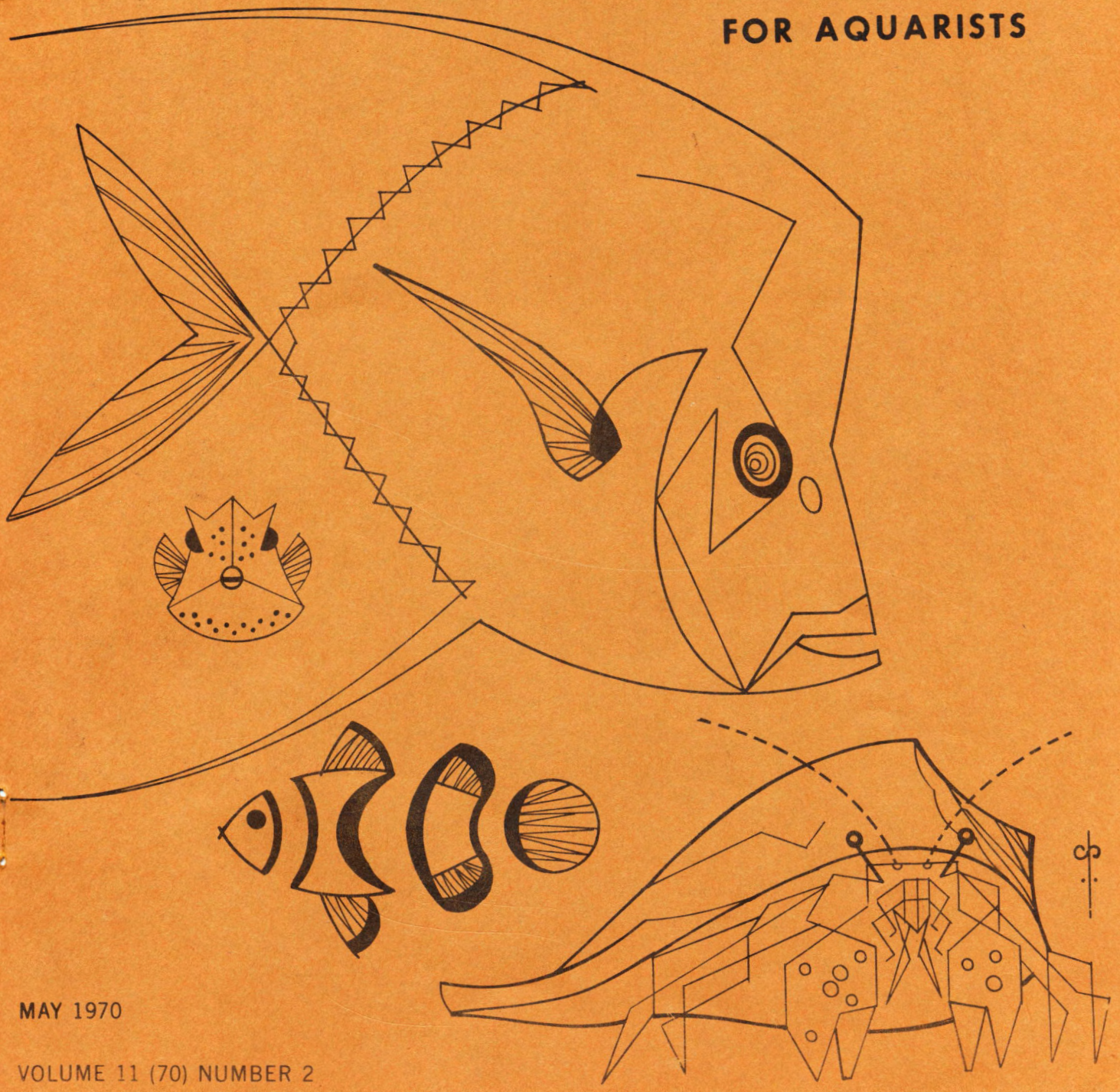
DRUM & CROAKER

THE INFORMAL ORGAN

FOR AQUARISTS



MAY 1970

VOLUME 11 (70) NUMBER 2

The Frankfurt Zoological Gardens and their Director extend cordial Easter Greetings and best wishes for a successful summerseason to all friends in the whole world as well as to the animals under their care.

Mach Dir die Erde untertan!
Noch gibt es Wald und Busch zu roden.
Ein Wal bringt viele Tonnen Tran,
ein Panther Fell für teure Moden.
Noch gibt es Kohle, Öl und Erz.
Mach das zu Geld! Genieß, mein Herz!

Nur frage nie, wie's weiter geht,
und was dann bleibt für Deine Kinder!
Die kommen leider ja zu spät. —
Auch nicht der pfiffigste Erfinder
stellt wieder her, was Du bei Nacht
und Tag leichtfertig umgebracht. —

(Vielleicht sind sie's dann schon gewohnt:
Die Erde öde wie der Mond.)

Conquer the earth! Still there are
Woods and bushes to plough and spoil,
A whale brings tons and tons of oil
A panther means skins and fashions galore
There's plenty of coal and oil and ore
Turn it to cash! Enjoy it so far!

But do not ask what follows then
And what remains for your children
They come too late, alas!
Not even the most brilliant inventor
Can reinstate those things so crass
Now utterly destroyed.

(Perhaps they're used to it, but soon
The earth's as desolate as the moon.)

J. Andereich

VOLUME 11 (70), NUMBER 2 MAY 1970

DRUM AND CROAKER

The Informal Organ

for

Aquarists

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Washington, D. C. 20240

Art work by Craig Phillips, NFCA.

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.

COMMENT

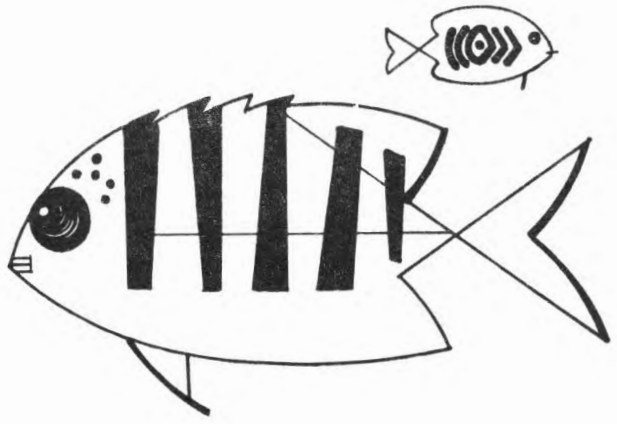
Sometime ago we mailed to most major aquariums in the United States and Canada, and to a few overseas, a letter proposing that some future issues of DRUM AND CROAKER be devoted largely to some single subject, such as filters, people handling, etc. We had proposed as a first special to concentrate on education at aquariums. We had specified no deadline on receipt of material but had suggested May 1.

May 1 is somewhat behind us and we have received only one response, a very well written piece on the student and docent program at Vancouver, with photos.

As we are putting this issue of DRUM AND CROAKER together we ponder over the worth of the effort. Considering that our mailing list is above 300, one would expect more contributions. Only three or four of you are faithful in sending in your own or "lifted" articles. To fill out DRUM AND CROAKER we also lift items. We can't even get you to send in a brief article about a collecting trip, or personnel changes.

We'll put this issue to bed and forget about it for a couple of months.

Wm. Hagen
Asst. Director - Operations,
NFC&A



DRUM AND CROAKER

MAY 1970

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PROFESSIONAL AQUARIUM SYMPOSIUM

ICHS AND HERPS MEETING - NEW ORLEANS

March 1970

The 16th Annual Aquarium Symposium at the fiftieth Annual Meeting of the American Society of Ichthyologists and Herpetologists, was held in New Orleans, Louisiana, March 26-30. The convention headquarters was the Fontainebleau Hotel and the host institution was Tulane University.

The accommodations were roomy and comfortable. The conference rooms were filled to overflowing and there was a last minute rearrangement of conference rooms to accommodate the underestimated attendance. There were a number of interesting papers given by both the professional aquarists and ichthyologists. Some of which are abstracted in this issue of DRUM AND CROAKER.

On Saturday evening a smoker was held in the Hotel ballroom and there was plenty to go around. Between Bourbon Street and the other bourbon, everyone enjoyed the socializing and personal communication that transpired. A smoker permits the exchange of information and filling of the formal meeting gaps.

There were three formal field trips organized by the convention committee on Easter Sunday for those who were early risers (after a smoker ?).

On Easter Sunday afternoon the professional aquarists were the guests of Dr. and Mrs. Joseph Schlosser and their three charming daughters at a cocktail party held in Dr. and Mrs. Schlosser's beautiful home with its authentic New Orleans furnishings. After the cocktail party, the evening was continued with a no-host dinner at Brennan's, one of the finest restaurants in New Orleans. All who accepted Dr. Schlosser's hospitality will never forget New Orleans and many were

heard to accept invitations to return for Mardi Gras when "anything goes."

With dinner complete the evening was still young and most were still in the mood for exchanging ideas. So back to the hotel went the caravan aquarists to hold an impromptu discussion on matters that concern aquarists, organizationalism, belongingness, achievement, etc.

The discussion dwelt mainly on the future of the aquarium symposium. Should professional aquarists continue to meet in conjunction with the ASIH or should they meet with the American Association of Zoological Parks and Aquariums, or the Ecological Society, or should they form an association of their own and meet whenever they felt it would be convenient? Many felt that there was need of some change - that the poor stepdaughter role should end and we should have more to say as to how, when and where we meet and the scheduling of events.

Bill Braker had indicated a desire to resign as aquarium committee chairman, and as there was a majority of aquarists in attendance, it was suggested and voted upon that Earl S. Herald of **Steinhart** Aquarium be appointed to succeed Bill who has given so much of his time to the organization in the past few years. Bill has become very busy of late and felt he could not do justice to the position. (Subsequently Bill did resign.)

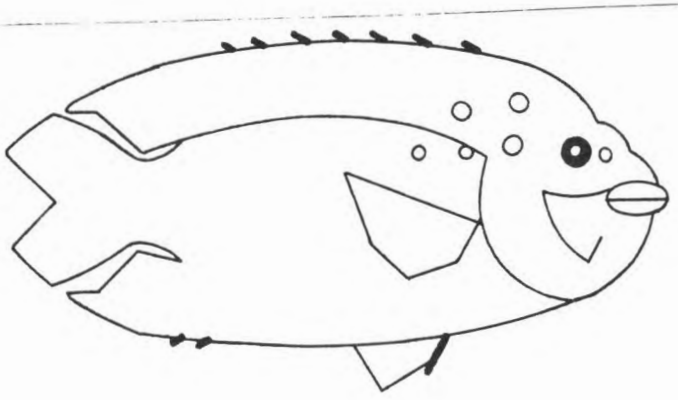
Earl Herald suggested that the aquarists delay any decision regarding future organization until the meeting next year in Los Angeles. Marineland of the Pacific and Sea World of San Diego will be the host institutions. Earlguaranteed that John Precsott and Dave Powell would show us a good time. They have a number of new attractions and innovations most of us have not seen yet.

At approximately 3:00 AM on Monday morning the meeting adjourned as dawn would soon be breaking. The following enthusiasts were in attendance for this meeting:

Bill Flynn, Pittsburgh
Louis Garibaldi, Washington, D. C.
Earl Herald, San Francisco
Gerrit Klay, Marathon, Fla.
Dan Michalowski, New York
Paul Montreuil, Montreal
Jeff Moore, Dallas, Texas
Dan Moreno, Cleveland, Ohio
Bob Morris, New York
Murray Newman, Vancouver, B.C., Canada
Vince Penfold, Vancouver, B.C., Canada
Steve Spotte, Niagara Falls
Bill Strizek, Chicago
Elmer Taylor, Boston
Rick Vahan, Chicago
Tom Whitman, Redwood City, Calif.
Warren J. Wisby, Washington, D. C.
Warren Zeiler, Miami

The final aquarium papers were given on Monday afternoon (luckily not Monday morning) and the convention banquet was held that evening. With assurance it can be said that all who attended the convention found it a rewarding and enjoyable gathering and are looking forward to next year.

Louis E. Garibaldi
NFC&A, Washington, D. C.



The PERT Approach to Aquarium Management. Herman E. Kumpf, Fishery Biologist (Research), National Fisheries Center and Aquarium, Washington, D.C.

ABSTRACT

PERT (Program Evaluation and Review Technique) is a method of project networking used in many areas of Government and industry. Background information and development of this approach is given. Network construction and diagrams are developed. Time factor analyses are discussed. The application of the technique to planning, programming, and allocation of funds and personnel, as applied to aquarium management, is presented. Benefits of such a system are illustrated.

******

Operation and Principle of the "Protein Skimmer" in Aquarium Systems. Herman E. Kumpf, Fishery Biologist (Research), National Fisheries Center and Aquarium, Washington, D.C.

ABSTRACT

Foam separation is a common tool of chemical engineering. Background use of related sea-water extraction is presented. Bubble size and air-flow rate are the prime controlling factors in extraction. Several bubble producers are figured and discussed. Protein extraction has been accomplished in low salinity (less than 1 ppt) as well as normal sea-water. Proportional configurations of the protein skimmer are presented and discussed from a practical, aquarium management viewpoint. The several processes occurring during operation are discussed. Work By Huckstedt, Fach, Wallace and Wilson, as well as that of the author, are summarized.

Presented at the 16th Annual Aquarium Symposium of the A.S.I.H., New Orleans, March 26-31, 1970.

THE PERIODIC 24-HOUR MONITORING OF SELECTED WATER QUALITY CRITERIA IN RECIRCULATING FRESHWATER AQUARIA(1)

John R. Leonard(2)
National Fisheries Center and Aquarium

During each week from October 22 to November 27, 1968, urea, ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, dissolved oxygen, pH, and temperature were measured the maximum number of times possible in a 24-hour period. The water in the twelve 23-gallon aquaria, each containing 22 goldfish weighing about 120 grams, was recirculated through a 20-pound mixed oyster shell and gravel filter 18 times every 24 hours. The chemical and physical water quality factors were monitored during the following five 24-hour periods: 1 week before the fish were placed in the aquaria; and 2 hours, 1 week, 2 weeks, and 3 weeks after the fish were placed in the aquaria.

During the study the temperature of the water ranged from 19 to 24 degrees Centigrade. The temperature was usually highest in the late afternoon and lowest from 8:00 a.m. to 10:00 a.m. in the morning.

An average dissolved oxygen concentration of 6.5 was recorded before fish were placed in the tanks.(3) When fish were added the level dropped sharply to below 6 and as the fish became acclimated increased to 6.3. In the following 3 weeks the dissolved oxygen values ranged from 2.3 to 4.6. Each daily feeding at 6:00 p.m. resulted in a decrease in the oxygen concentration which continued until midnight and then a slow but steady increase occurred.

The pH of the water rose gradually to about 8.3 until the fish were placed into the tanks. At this time the average pH dropped rapidly to 8.0 and over the next two weeks declined slowly, stabilizing at 7.7. A drop in pH of the water generally occurred within 6 hours after the fish were fed. The water then became more alkaline.

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(1) Read by title at Aquarium Symposium, New Orleans, March 1970.
(2) Fishery Biologist-Research, Washington, D.C.
(3) All numerical values given, except for temperature and pH, are presented in parts per million.

The concentration of urea ranged from less than five(4) before the fish were added to the tanks, to nine 3 weeks after the fish were added. No definite times or patterns of peak concentrations were evident.

The ammonia-nitrogen (NH_4.N), which was less than .05 before the fish were placed in the tanks, rose slowly to .2 after the fish were added. In one week the concentration was about .6, but decreased to approximately .2 by the end of the 24 hours of sampling. For the remaining two sampling periods the amounts of ammonia-nitrogen in the tank decreased and stabilized at the .05 level.

The nitrite-nitrogen concentration (NO_2^-.N) began lower than .005 and did not increase during the second sampling period which immediately followed the placement of fish into the tanks. During the third sampling period the concentrations, which were about .250 for initial samples, decreased to .170 in the final samples. The values had decreased and remained at the .01 level for the 4th and 5th periods. A slight increase in the NO_2^- concentration was observed around 2:00 a.m. during the last two sampling periods.

The nitrate-nitrogen (NO_3^-.N) concentration was about 1 before and immediately after the fish were added to the tanks. One week later the values rose to 4.5 and continued to increase to 11 and 16 in the 4th and 5th sampling periods respectively.

The fluctuation of the majority of the chemical concentrations with time can be simply explained by the biological oxidation of NH_4 to NO_2^- and then to NO_3^-. For example, as the NH_4^-.N concentration decreased, NO_2^- increased and as NO_2^-decreased the NO_3^-.N increased.

The data also indicate that the most critical time of acclimating a fish in a tank would be the first or second week. After that time tanks which were loaded, circulated, and filtered similarly to those in this study should be approaching a relatively stable condition with the exception of the nitrate concentration.(5)

It is my opinion that valuable information could be gained in more closely examining this critical period (the first two weeks after fish are placed into a tank) by continuously monitoring selected physical and chemical variables for the entire period.

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(4) Sensitivity of the AutoAnalyzer for the analysis was unable to detect less than 5 ppm.

(5) Concentrations of less than 100 are usually considered non-toxic to fish.

THE APPLICATION OF FLUIDICS IN THE AQUARIUM

Louis E. Garibaldi*

Fluidics, as the name implies, is the science of fluids in motion. The fluids can be either air or water, but we are most interested in the application of this new technology using water.

By utilizing fluid-dynamic phenomena, such functions as sensing, control, information processing and actuation can be performed where electronics were previously used. In the realm of fluid-power such functions as switching, flow controls, pressure control and force control can be accomplished with fluidics, but working hardware is not commercially available for all functions at the present time.

Typical fluidic tools are surface phenomena and the phenomema of interacting streams both of which used together or independently accomplish control and switching without moving parts. A stream of fluid flowing close to a surface tends to be deflected toward the surface and under proper conditions touches it and attaches to the surface. When interacting streams are involved, one or more streams are used to influence or control the direction of flow of the power stream. Using these phenomena, a two-way valve can be made without any moving parts.

---

*Acting Assistant Curator-National Aquarium, National Fisheries Center and Aquarium, U.S. Department of the Interior, Washington, D.C. 20240

Presented at the 16th Annual Aquarium Symposium of the A.S.I.H., New Orleans, March 26-31, 1970.

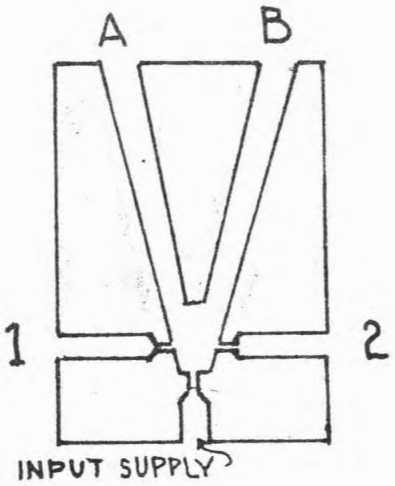


FIGURE 1

The schematic diagram shows a device that has a supply, two control ports and two alternate outputs. When a fluid stream (water for example) is supplied to the supply port, the fluid flows from either the left or right output port. This "valve" is stable in two states and is known as a bistable or flip-flop. The output can be switched from one output port to the other by a control flow applied to the control nearer the supply stream. In other words, a control stream applied to control "1" would switch the output from "A" to "B." The supply stream is maintained stable in its new position by the surface active phenomena and the control stream can be removed. In this device, in order to switch the outputs back again, a second control stream must be applied to the opposite control port (2).

Prejudices can be built into the design in order that the "valve" will be monostable or have a preference for one output over the other. In which case, the stream would always return to the preferred output when the control stream was removed.

This device and variations of the same design may be the most useful in aquarium applications. They can be built to any size to suit the application small or large.

They can also be made from a variety of non-corrosive materials such as plexiglass, epoxy, fiberglass, or P.V.C.

All systems making use of this "valve" can be designed to operate automatically with automatic feedbacks designed to perform the desired function.

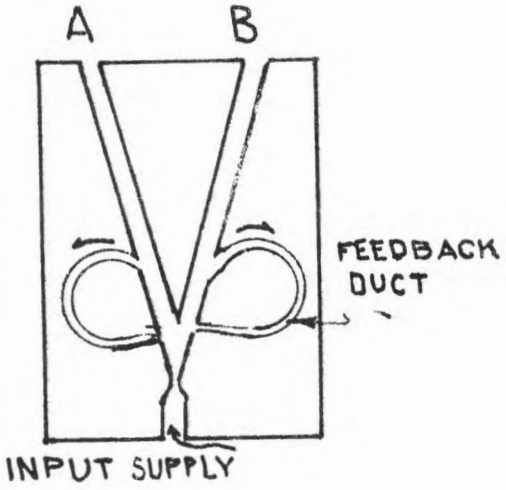
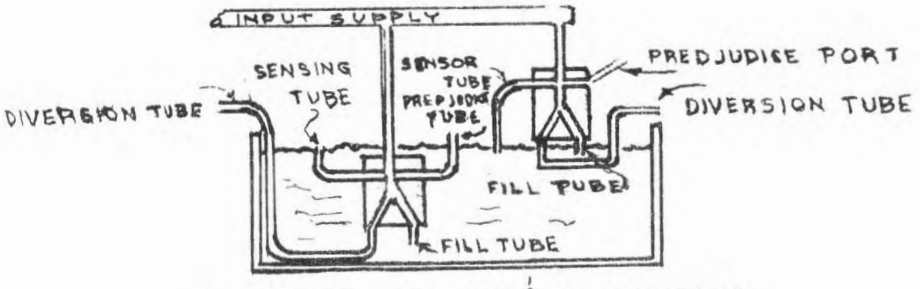


FIGURE 2

A system similar to that in Figure 2 would oscillate between outputs "A" and "B" with the time interval built into the design and controlled via the feedback ducts.

Liquid level controls can be operated by use of the prejudiced "valve" as in Figure 3.

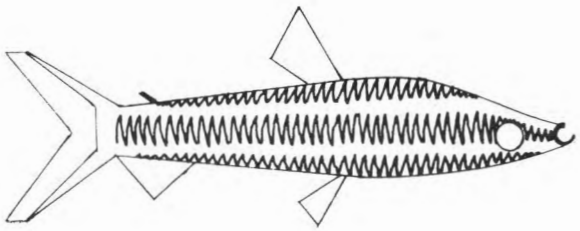


FLIP-FLOP - WATER/AIR CONTROL

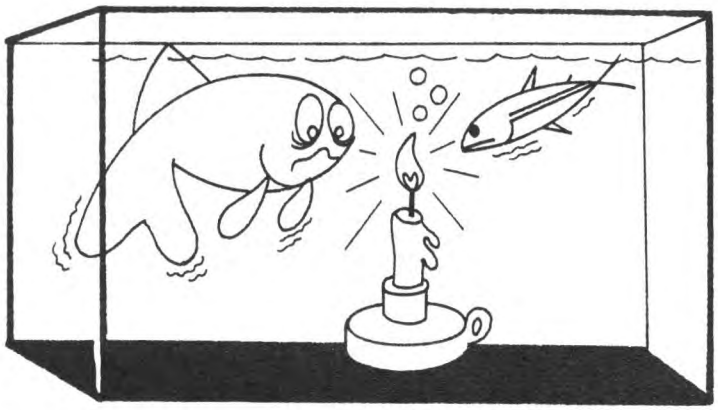
This type of control can be used to maintain the levels in storage reservoirs as well as exhibit tanks that are on a master circulation system. This passive device would prevent overflow due to clogged drains by diverting the supply to another area.

Displays with fluctuating currents can be created with an oscillating "valve" that would alternately direct a current from first one direction and then the other. Intertidal and coral reef fishes seem to prefer currents and alternating currents would keep the fish alert and active. It was in searching for advice to accomplish this effect that led us to the technology of fluidics.

These are only a couple of suggested uses of fluidic devices in the aquarium field. There are many other applications we are sure, but they must be investigated. Possibly aquariums of the future may have entire systems automated with fluidic circuits.



ERICH FRIESE, formerly Assistant Curator, Coney Island, has accepted a position as Curator of Fishes, Tarongo Zoo, Sidney, Australia.



SOME INEXPENSIVE ELECTRIC IMMERSION HEATERS FOR LARGE TANKS

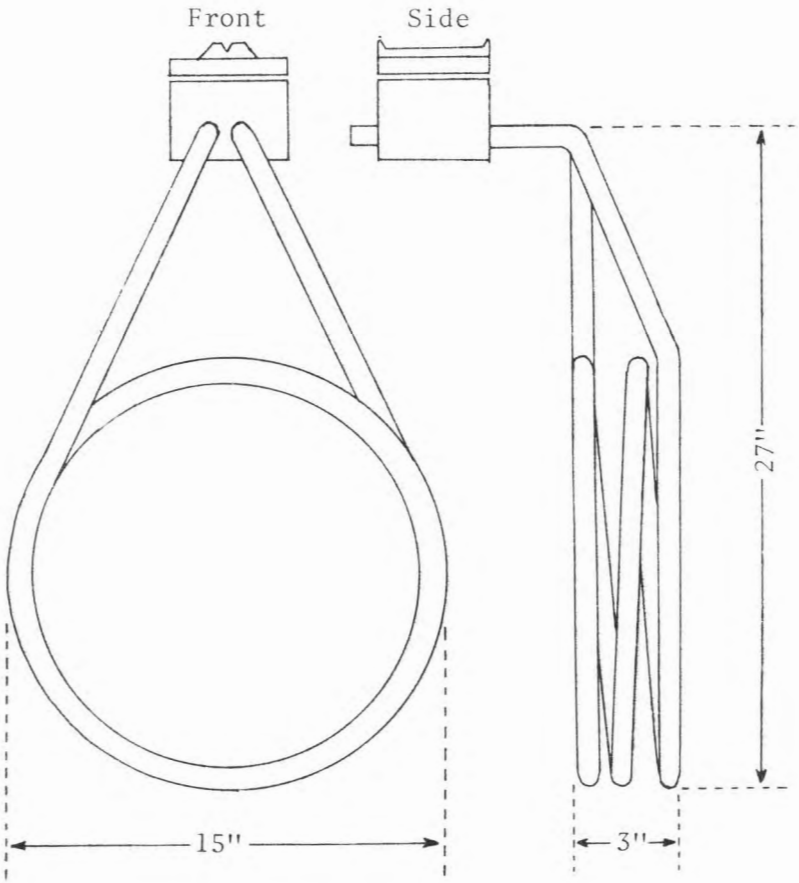
Richard M. Segedi
Cleveland Aquarium

When the Cleveland Aquarium acquired some new large tanks along with its new addition in 1967, one of the problems we encountered was a way in which to heat those tanks. Most of the heat for (all of) our systems is provided by the general heating of the building. The ambient temperature of the systems is about 70°F. when utilizing only the building heat. Some of our large tanks hold tropical freshwater species which prefer temperatures in the mid-70's. The systems are 12,000 gallons each, so we needed high-wattage heaters.

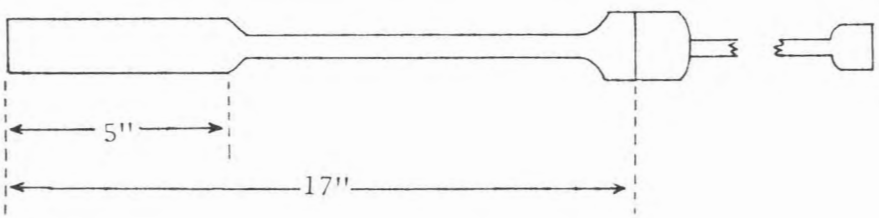
We wanted something flexible. Some sort of unit which would be movable in case the system on which it would be working were to be changed from tropical to nontropical. Immersion heaters such as those used by hobbyists would fill the bill nicely, only they didn't come in sufficiently high wattages.

We located a company which manufactures electric immersion heaters for industrial uses such as electroplating. Their catalog showed a great variety of heaters, so we tried several types and have settled on two basic kinds which we have found to be quite satisfactory. Both are "over the side" heaters. They come in a number of sheath materials, including some high-priced "noncorrodible" alloys.

VERTICAL IMMERSION HEATER
Type CT 5000 Watts 200 V



PORTABLE IMMERSION HEATER
Type CSL 500 Watts 110 V



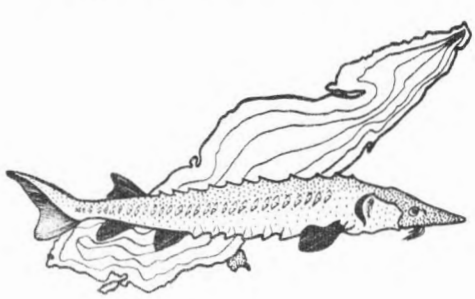
After a few months of use in freshwater in which fishes were living, however, even the heaters sheathed with the expensive exotic alloys corroded out. Coating them first with epoxy only extended their lives by a few months. Though these expensive metals are used industrially in all sorts of corrosive solutions they don't hold up in "fish water."

The company carries copper sheathed models which we had been shying away from for obvious reasons, but by now we were ready to try anything. We reasoned that if the copper were treated with epoxy paint, even if some would peel off, only tiny amounts of copper would be exposed to the water. In 12,000-gallon systems, the amount of copper getting into the water would be negligible. So we tried the copper sheathed models and after a year of use there are no signs of deterioration on either the heaters or the fishes. We have even used these heaters in sea-water systems with no ill effects.

Wattage needed per gallon can be calculated by using the following general formula: 1 watt per 10 gallons of water will raise the temperature of the water 1°F. over ambient. There will be some variance in this due to container configurations governing surface area where heat loss might occur. However, it does work well for any "normally shaped" aquarium. We use 5000 W heaters in our 12,000-gallon systems and get a temperature increase over ambient of 5° to 6° F. For those not willing to trust figures, the heaters can be equipped with thermostats.

The heaters are manufactured by Cromalox and are distributed by the Edwin L. Wiegand Company, 7500 Thomas Boulevard, Pittsburgh, Pennsylvania 15208. The 5000 W model is catalogued as CTC-50, requires 220-240 volts and sells for $18.00. We also use a 500 W model (CSL-1160) which requires 110 volts and lists at $15.30. Both of these heaters are illustrated here.

Heaters such as the types described here may not only be used as permanent tank heaters, but their portability make them good emergency heaters as well.



NOMENCLATURE 

Aquaria, Aquarium, "Aquarius"

The American Heritage Dictionary, 1969

"Aquarium, pl. - ums or ia. 1. a tank, bowl, or other water-filled enclosure in which living aquatic animals and, often, plants are kept. 2. a place for the public exhibition of such animals and plants."

Webster's Third New International Dictionary, 1961

Essentially the same as above, but includes "an artificial pond."

Although this has been kicked around before, we'd like to suggest standard usage:

1. Aquarium: a) A building housing aquaria.
   b) A single display tank.

2. Aquariums: a) Two or more buildings housing aquaria.

3. Aquaria: a) Two or more display tanks.

****

*As Jim Atz notes,"*** editors may balk at two plural forms for a single word." But he and several others have expressed agreement with the above proposal. Jim says, "*** by all means try to establish this clarifying usage."*

See also "A Brief History of the Word Aquarium," J.W. Atz, The Aquarium Journal, January 1949.

HOW SAY YOU???

A NEW AQUARIUM IN ICELAND

Richard M. Segedi
Cleveland Aquarium

In August 1969, my wife and I spent our vacation touring Iceland. At the outset we never expected to find an aquarium there, but while visiting the small Natural History Museum in the capital, Rejkyavic, we were told that there were two aquariums there, one on the Westman Islands off the south coast and a new one in Hafnarfjorhur, a small town just south of Rejkyavic.

We took a bus to the town and were taken towards the aquarium. I say towards because the bus line ended at the beginning of a gravel road that led out onto a deserted lava field. The driver told us to strike out down the road and when we come to a smaller road leading to the right to follow that to the shore where we would find the aquarium.

Though it was August, the temperature was in the low fifties, and it was windy and drizzly such as it is in the northeastern States in November. We were not in the mood for a long walk, but curiosity had the best of us so we started. There was a family of Icelanders just ahead of us who we thought must live somewhere along the road. We walked on admiring the fantastic shapes formed by the lava as it had moved onto that plain a few hundred years ago. As the road wound farther from the town things got more and more desolate 'til there was nothing but the family ahead and us and the lava field.

Surely we were on the wrong track. We must have misunderstood the driver, but we kept going thinking we might as well enjoy the scenery. We could always turn back.

Then we came to the road leading off to the right. There was a sign stuck in the ground announcing "Saedyrasafnid." The word, we found meant aquarium. Icelanders keep their language pure by refusing to use foreign words, including Latin. When the need comes for new words, they coin them by combining old Icelandic words. "Saedyrasafnid" developed from "sae" meaning sea, "dyra" like the German "Tiere" for animals, and "safnid" which means collection.

This new road finally led to a small group of buildings in front of which stood the bridge of an old fishing boat. This we found to be the ticket booth and office so we followed the Icelandic family through the turnstile into the exhibit area. A young fellow whose name was Gunnar Jonsson was feeding some penguins and when we introduced ourselves offered to get the Director, whose name was Jon Gunnarsson. Mr. Gunnarsson was the boy's father. According to custom the boy had for a surname his father's first name with the suffix "son" attached. When we met Mr. Gunnarsson he explained this custom to us and added that girls have the suffix "dottir" added to their fathers' first name as their surname and do not change their names on marrying. "This leads to complications when checking into hotels in other countries," Mr. Gunnarsson remarked.

The aquarium was rather small and obviously newly founded. There were several outdoor exhibits in an enclosed yard, and a low L-shaped building housed about a dozen concrete exhibit tanks of about a thousand gallons capacity each. All contained saltwater animals. Mr. Gunnarsson explained that there were no provisions as yet for freshwater creatures or for heating the sea water for tropical animals. Consequently, all of the animals were native, mostly cod, lumpfish, wolf-eels, and spiny dogfish. The location of the aquarium was chosen for access to a sea-water aquifer which was sufficiently away from harbors and rivers to avoid pollution or dilution of the supply. Secondly, the aquarium needed room to expand, of which there was plenty in that location.

The outside exhibits consisted of a large enclosure for seals, one for penguins, and one for, of all things, arctic foxes. The foxes were there because they were donated by an enthuiastic supporter of the new aquarium and since there is no zoo on Iceland, they were quite a hit with the visitors. A raven was also shown in another cage, and it was for the children because there is an Icelandic fairy tale dealing with this bird.

The aquarium had just opened officially in May of 1969. It had been started as a project for a local chapter of the Boy Scouts and received so much attention and enthusiasm from the people that it was expanded to its present size and kept as a permanent facility. From May until August, when we were there, 50,000 people had visited it. This is a quarter of the population of Iceland. A remarkable record, especially when the remoteness of the exhibit is taken into account.

Currently, Mr. Gunnarsson has plans to excavate a large pool for whales. He mentioned that sometime late this year he and some of his trustees plan to visit the States to seek information on whale capture and maintenance. I think he has a good prospect for success from the layout of his facility, its location in relation to water supply and the enthusiasm of the people who will ultimately support it.

I know that when he does come to our shores he will be well received by us and that we all will be as co-operative as possible, for a dedicated group such as theirs deserves our wholehearted assistance.

Anyone wishing to contact Mr. Gunnarsson can do so by writing to:

Mr. Jon Gunnarsson, Director
Saedryasafnid
Box 224
Hafnarfjordur
Iceland

ISSUES OF DRUM AND CROAKER

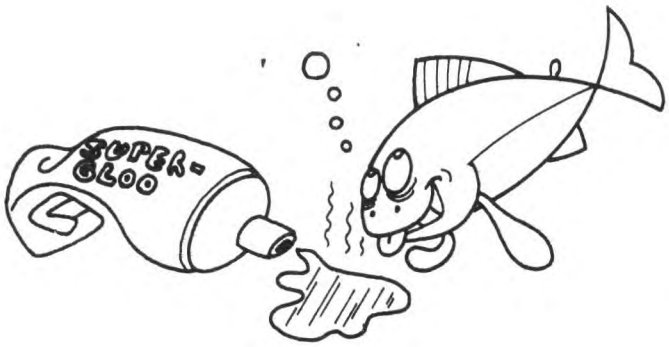
In the January issue of DRUM AND CROAKER we explained, as best we could, the origins of this periodical, including the disconcerting volume-numbering system.

Below is our listing of all issues of DRUM AND CROAKER to date. If we have missed some please advise. Note that 1960 and 1967 were blanks. Copies of back issues are not available.

Year	Month	Volume No.	Issue No.	Actual Vol. No.	Editor
1958	June	--	1	1	Herald
1959	Jan.	--	2	2	(Steinhart)
	July	59	7	2	Finneran
1961	Oct.	61	10	3	(New England)
1962	April	62	11	4	"
	Sept.	--	6	4	"
1963	June	--	--	5	Kelley (Cleveland)
1964	July	64	1	6	Prescott
1965	--	65	1	7	(Marineland Pacific)
	--	65	2	7	"
1966	--	66	1	8	"
1968	Jan.	68	1	9	Phillips
	May	68	2	9	(NFCA)
	Sept.	68	3	9	"
1969	Jan.	69	1	10	Hagen
	May	69	2	10	(NFCA)
	Sept.	69	3	10	"
1970	Jan.	70	1	11	"
	May	70	2	11	"

In the interest of those who like a bit of cataloging sincerity--librarians and, perhaps, aquarists--we are revising slightly the volume numbering. We retain the year designation in parentheses, but also utilize the actual volume number, e.g., Volume 11(70), Number 2.

We trust that those who conceived and mid-wifed this journal will not be outraged.



BEWARE OF CARPET GLUE!

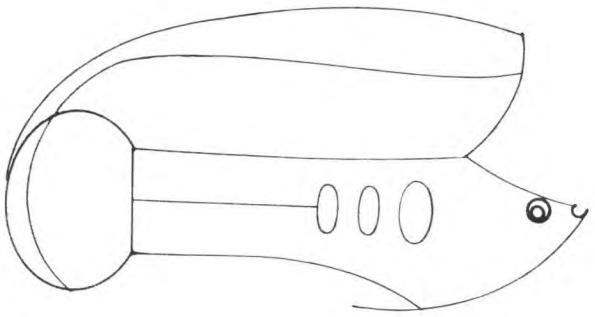
Robert A. Morris
U. Erich Friese
New York Aquarium

Recently the New York Aquarium installed a new carpet of the indoor-outdoor type in the main exhibit hall. Installation was done after closing hours and due to the cold weather the doors to the outside area were kept closed. The next morning, we were greeted by a terrific odor of glue in the main hall along with some drastic changes in the appearance of our small exhibits. The glue was used to adhere the carpet to the floor.

There are 14 small exhibit tanks on one side of the main hall, each approximately 100-gallon capacity. Three of the 14 are freshwater and the remaining tropical marine. All of the freshwater tanks were normal in appearance, but eight of the marine exhibits were so cloudy that we had difficulty seeing the fish. One of these tanks (the one with the greatest mass of fish per water volume) was very cloudy with all of the fish dead. The fish in the other cloudy tanks showed signs of stress manifested by rapid breathing. A check on the cloudy tanks revealed severe oxygen depletion. Normal dissolved oxygen readings for the exhibits range from 4.5 to 6.4 ppm. The cloudy tanks ranged from 1.0 ppm to 4.5 ppm. The clear tanks had normal oxygen readings. Aeration and water changes saved all of

the remaining fish. None of the large 1,000- to 3,000-gallon exhibit tanks were affected. Careful experiments clearly demonstrated that the glue fumes caused cloudy water and oxygen depletion. Further inquiry from the glue distributor (American Biltrite Rubber Company, Inc.) revealed that the adhesive was #215 Amtico waterproof cement. The main volatile in the glue is ethyl alcohol, with the following denaturants: 5% ethyl acetate, 5% methanol and 1% isobutyl ketone. All of these volatiles are water soluble except methyl isobutyl acetate. The exact causative agent for the oxygen depletion was undetermined.

It is hoped that other aquariums will be aware of the potential damage from such glue fumes and avoid it by proper ventilation.



HOW MUCH ELECTRICITY DOES AN ELECTRIC EEL GENERATE?

Although the electric eel (which isn't a true eel) is the best known generator of electricity, there are at least 500 kinds of fishes that generate appreciable amounts of electricity. The electrical discharge serves to stun prey and repel attackers.

The average discharge is more than 350 volts, but discharges as high as 650 volts have been measured. Current is low, usually a fraction of an ampere; however, brief discharges of 500 volts at 2 amperes have been measured, producing 1,000 watts. Although direct current is produced, it may be discharged as frequently as 300 times a second.

Severity of the shock depends on the size and state of health of the fish. Voltage increases until the eel reaches a total length of about 3 feet; after that, only amperage increases. Electric eels in South American waters have been known to grow to a length of almost 10 feet.

Other electric fish are found in other parts of the world. ('Questions About The Oceans,' U.S. Naval Oceanographic Office.)

PLASTIC PLANTS CAN BE DEADLY!

William Flynn, Curator

and

James S. Kepley, Aquarist
The Pittsburgh Aquarium

One of the most prized exhibits at the Pittsburgh Aquarium is our display of the giant arapaima *(Arapaima gigas)*. We have had four large, healthy specimens since our opening in September 1967. They range in size from 34 to 58 inches and are fed large quantities of goldfish supplemented with chicken heart. Normal coloration is bronze and black-flecked with red.

During the early part of December 1969, we noticed a color change in our 38-inch specimen from bronze to silvery-gray. This color change coincided with a loss of appetite, general listlessness, and a noticeable loss of weight to the degree of having the scales protrude. Fearing an external parasitic infection, the fish was moved to a smaller holding tank on December 28, and treated with malachite green. Food in the form of live goldfish was constantly available, but no interest was shown by the arapaima.

The fish's health continued to decline until January 7, when it was decided to attempt an injection of cyanocobalamin (vitamin B-12) 1,000 mcg per cc and Duracillin 300,000 units per cc. It was our hope to stimulate the arapaima's appetite as well as control any internal infection caused by the injection. One cc of cyanocobalamin and one cc of Duracillin were mixed in a syringe and injected in the caudal area. The fish was captured in a large net and lifted out of the tank for this procedure.

Shortly after the injection the arapaima began exhibiting signs of distress normally associated with shock or water toxicity. In three hours the fish was dead despite efforts of aquarium personnel to revive it.

A post-mortem was performed the following morning by Curator William Flynn, with aquarists James Kepley and Peter Schepis assisting. We began the examination fully expecting to find a blockage of either the stomach or the intestine, but we were shocked at the massive infection we found. The gas-bladder and pneumatic duct were infected to the point of autolysis, and the infection had progressed to the liver. Infection was evident around the stomach and intestinal tract, and the stomach was shrunken and contained only grains of sand. The cause of all this damage---a 7-centimeter piece of artificial plant lodged in the neck of the pneumatic duct, at the roof of the esophagus. The final cause of death was attributed to shock brought on by massive infection and starvation.

It is believed that the arapaima inhaled the piece of broken plant while gulping air at the surface of the tank, and was unable to cough it out due to the way it had lodged, arrow-fashion, at the narrow neck of the pneumatic duct.

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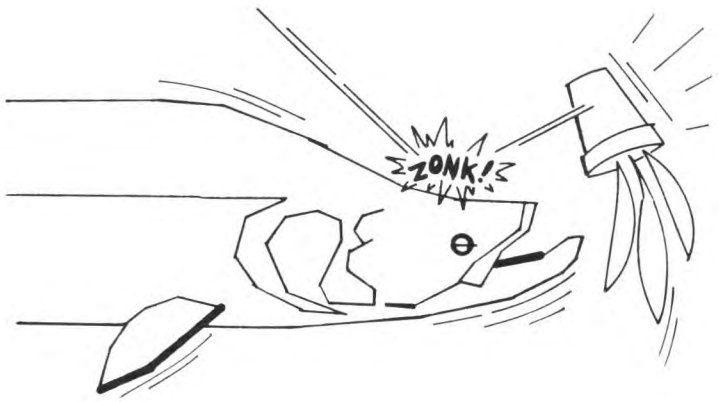


SWIMMING BEHAVIOR OF THE BONNETHEAD (*Sphyrna tiburo*) IN SHALLOW WATER

Gerrit Klay(1)

In a previous issue of DRUM AND CROAKER (1969, #1), we communicated some observations on the maintenance and behavior patterns of Bonnethead sharks, *Sphyrna tiburo*, in the Cleveland Aquarium. Since that time Bonnethead sharks shipped by the author have been successfully maintained by major aquariums in New England, the Midwest, and the West Coast.

The present communication concerns itself with some data on the collection of Bonnethead sharks in various coastal locations bordering the Gulf of Mexico. Additional field observations are described under various conditions of their natural habitat.

The accompanying map (Fig. 1) indicates locations along the Gulf of Mexico where Bonnethead sharks have been collected by the author. Clearly, the Bonnethead shark is common and widely distributed in coastal water. The Bonnethead has been observed at all times of the day. Its swimming pattern seems to depend on the tides and the depth of water in which they are found.

Of the locations indicated above, behavior observations could be carried out most satisfactorily on the Atlantic side of the Florida Keys in the region of Marathon (Vaca Key and Boot Key). Although sharks were frequently sighted and captured in all the indicated locations, the Atlantic side of Boot Key provided best field observations due to calmness and relative clarity even in the shallow water.

(1) Shark-Quarium Experimental Station, Marathon, Florida 33050.

Fig. 1. Areas (+) where author has observed and collected Bonnethead Sharks (*Sphyrna tiburo*).

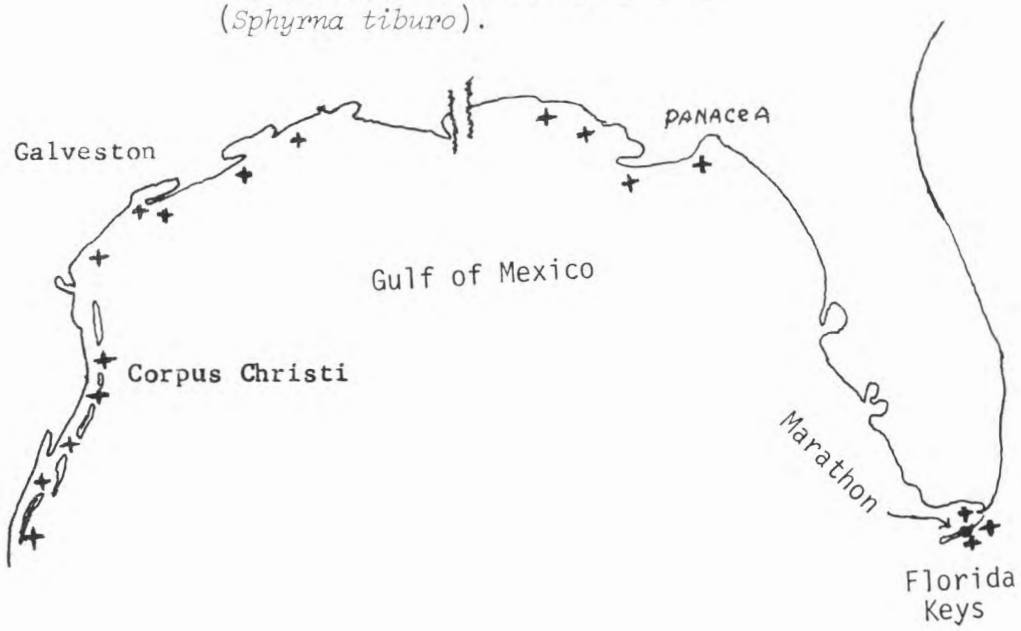
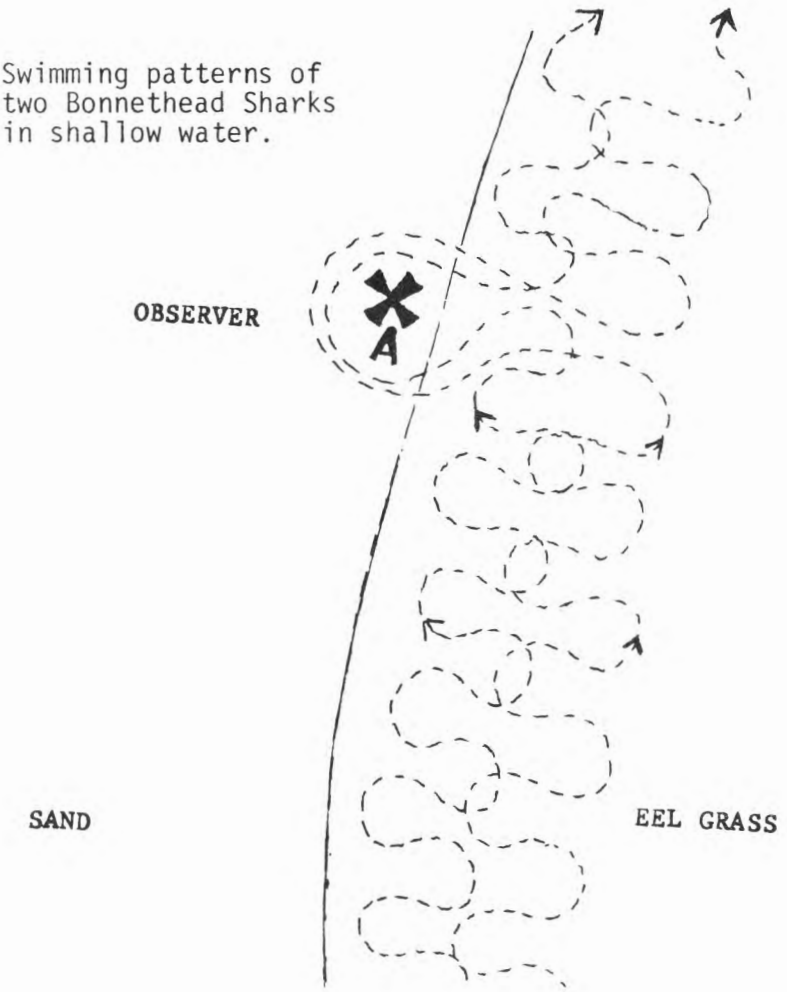


Fig. 2. Swimming patterns of two Bonnethead Sharks in shallow water.



Two basic types of swimming patterns have been observed. The usual cruising pattern is customarily observed in relatively deeper waters (three feet and deeper) and consists of linear forward motion. The second and much more interesting swimming pattern is more frequently observed in much shallower water. This type of swimming usually occurs in areas of relatively sheltered flats with the bottom consisting of patches of mud, grass, and sand. This swimming pattern follows a weaving or zig-zag path. This occurs with sharks swimming either singly or in groups as large as half a dozen. Each animal's head also swings back and forth as it cruises a course two-foot laterally paralleling a sand bar or turtle grass ledge for a distance of several hundred feet. The dorsal fin frequently protrudes from the water and can be seen from some distance. The accompanying diagram (Fig. 2) depicts a typical swimming pattern by two sharks. The observer was standing at Point A where deviating loops probably represents the response of the sharks when first noting the observer. After deviating briefly from their original course, they resumed previous direction of travel. Periodically, the smooth weaving pattern is interrupted by episodes of frenzied activity. One or several animals swim in a circular or erratic pattern occasionally splashing the surface as their caudal fins break the water. This frenzied activity is thought to represent an encounter with a blue crab or other crustacean. Upon examination of thirty specimens 80 percent contained fresh portunid crab remains. This type of pattern was usually observed at low tide when portunid crabs leave the emerging mangrove thickets and enter surrounding waters. It is assumed, therefore, that the weaving swimming pattern represents a search behavior pattern of Bonnethead sharks.

It is during this shallow water swimming that Bonnethead sharks are most accessible to capture by nets with least injury to the animal. A shark caught in this manner may be unharmed and vigorous if it is rapidly transported to an appropriate holding facility. The author has routinely maintained and air-shipped Bonnetheads in specially designed containers to public aquariums or research institutes. Bonnetheads lend themselves particularly well to aquarium

displays, due to their moderate size, very striking appearance, as well as their resemblence to the other Hammerhead sharks. It is a very active and constantly swimming shark. The Bonnethead shark is ideally suited for research purposes, particularly along the lines of behavioral studies and demonstrates complicated, "purposeful" and directed behavior oriented to its natural habitat in shallower waters. It, therefore, does well in captivity if appropriate preparations are taken.

Further studies along these lines are under way at the newly established Shark-Quarium Experimental Station using Bonnetheads, Bull Black Tips, and Lemon sharks.

Church's lighter side

"Drive carefully," warned the weekly bulletin at St. Phillip Presbyterian Church in Houston. "It's not only cars that can be recalled by their maker."

POLLUTED RIVER BURNS

"FAR ABOVE CUYAHOGA'S WATERS is an awful pall. This river, flowing through downtown Cleveland, is so polluted that it caught fire June 22. The blaze was large enough to set two railroad bridges afire, warping railroad tracks on both bridges. For years, many industries have been dumping industrial waste into the Cuyahoga, acting under permits issued by the State of Ohio." INDUSTRIAL RESEARCH 8/69. In the early days of the United States, rivers were so loaded with saw mill scrap and saw dust that they often would catch fire and burn for days. When will we ever learn?

THERAPEUTICS OF MALARIA *(Plasmodium relictum)* IN PENGUINS AT SEA WORLD IN SAN DIEGO, CALIFORNIA

David W. Kenney, D.V.M.
Sea World

INTRODUCTION

According to Petrak(1), about forty different species of avian malaria parasites have been described. *Plasmodium (Haemamoeba) relictum* (Syn. *P. (H) praecox)* occurs in many passarines and has been described as the cause of death in penguins in many parts of the world(1 thru 10).

The following species of penguins have been reported as having malaria:

1. Humboldt penguin, *Spheniscus humboldti*
2. Black-footed penguin, *Spheniscus demersus*
3. Blue penguin, *Eudyptula minor*
4. King penguin, *Aptenodytes patagonias*
5. Gentoo penguin, *Pygoscelis papua*
6. Galapagos penguin, *Spheniscus mendiculus*

An excellent review of the history, diagnosis and pathology of malaria in various species of penguins was given in 1967 by Griner (11).

Diagnosis

Malaria at Sea World generally is diagnosed at necropsy because the birds are in many cases clinically normal until found dead. In the specimens that had symptomatology before death, the following course was observed.

Partial to complete anorexia, depression, lethargy, avoidance of other birds, open-mouthed breathing in some cases, and lying down on sternum with head extended. The featherless area around the bill in some species would change from a normal pink to a pale creamy color as an indication of anemia. In some cases, a bilateral "bumble foot-like" syndrome of the feet would develop.

Possible Pathogenesis of Malaria in Penguins

According to Petrak(1), a penguin is bitten by infected mosquitos, usually being of the *Culex* or *Aedes* genera, however, in some cases as in mammals, they are bitten by the *Anopheles* genera. When they are bitten, sporozoites are released into the system. Within an hour they commence the exoerythrocytic stage of schizogony in the endothelial cells. Various changes occur in the organism until merozoites (metacryptozoites) are released into the blood stream and infect the erythrocytes. The merozoite in its early stage is known as a trophozoite and soon develops into a schizont which then releases more merozoites into the blood stream. These either reenter other erythrocytes or enter the endothelial cells.

The presence of merozoites in large numbers of endothelial cells causes swelling and partial to complete blockage(8). This increases peripheral resistance causing the vascular hydrostatic pressure to increase which predisposes to edema formation. This may show up as subcutaneous edema, pulmonary edema, pericardial edema with resultant tamponade and/or swelling of various organs due to interstitial edema. In addition, the end arterioles affected by merozoites could cause minute infarcts. The edema

so produced could gravitate toward the feet of these animals causing them to swell. However, this has yet to be proven. Eventually pulmonary edema and cardiac temponade could cause the death of the animal.

As indicated in Table III, the cases of malaria are seen primarily during the hot summer months. This is the period of greatest stress which is just prior to, during or just after the molting process. Some cases have been seen at other times. The penguins dying of various diseases each year are listed in Table I.

TABLE 1 MORTALITIES

Humboldt Penguin, *Spheniscus humboldti*

Year	On Hand Jan. 1	Acquired during Yr.	Total for Yr.	Died	% Deaths of Total	On Hand Dec.	Diagnosed *
1964	0	6	6	1	16	5	M
1965	5	16	21	9	42	12	M
1966	12	22	34	20	58	--	M
				2	5	12	A
1967	12	40	52	24	46	--	M
				24	46	4	S
1968	4	20	24	3	12	21	M
1969	21	30	51	2	12	--	D
				4	7	45	M
Blackfoot Penguin, *Spheniscus demersus*							
1967	0	12	12	5	42	7	M
1968	7	2	9	3	33	6	M
1969	6	0	6	0	0	6	
Rockhopper Penguin, *Eudyptes crestatus*							
1969	1	0	1	0	0	1	
King Penguin, *Aptenodytes patagonias*							
1969	6	0	6	0	0	6	

*M = Malaria, A = Aspergillosis, S = Salmonella, D = Drowned

TABLE 11

Summary -- All Penguins

Year	Total Birds	Malarial Deaths	Percentage
1964	6	1	16
1965	21	9	42
1966	34	20	58
1967	64	29	45
1968	33	6	18
1969	64	4	6

TABLE 111

Seasonal Occurrence of Malarial Deaths of *Spheniscus humboldti*

	1964	1965	1966	1967	1968	1969	Total
Jan.							
Feb.							
Mar.			3				3
April			1	2			3
May				1			1
June					1		1
July	1			2	1	1	5
Aug.		2	1	10	1	2	16
Sept.		5	6	3		1	15
Oct.		1	9	3			13
Nov.				3			3
Dec.		1					1

From 1964 through June 1968, treatment with common anti-malarial drugs such as chloroquine phosphate, quinicrine, and primaquin phosphate failed to alter the mortality rate due to malaria at Sea World although other authors indicated success with various of these drugs(11). In early 1968, the author while perusing the Readers Digest, came upon a small item describing a highly promising drug combination for the treatment of the falciparum type of malaria acquired by soldiers in Vietnam. One of the drugs in the combination was sulformethoxine, a new long-acting sulfa developed in Switzerland and handled by Hoffmann LaRoche, Inc., in Nutley, New Jersey, under the trade name of Fanzil and experimental designation of Ro-4-4393. As of this writing, sulformethoxine still has experimental status. The other half of the combination is pyrimethamine (Daraprim), an older anti-malarial drug which when used alone, soon loses its efficacy. This new combination was reported to kill the parasite in the blood in man and reduce the relapse rate to 2%. Correspondence with Hoffmann LaRoche soon produced a clinical sample for experimental use on penguins.

Hoffmann LaRoche gives the following information concerning Ro-4-4393 (Fanzil)(12).

1. LD_{50} mice 5g/kg

2. LD_{50} cats 10g/kg

3. Dogs tolerated a weekly oral dose of 200mg/kg for one year.

4. The LD_{50} against *Staph. aureus* in rats is 3.3mg/kg and against *Strept. haemolyticum* in mice is 2.9mg/kg.

5. The combination, the proportion of 1 gram Ro-4-4393 (Fanzil) to 50mg pyrimethamine (Daraprim) appears to be substantially more effective than the sulfonamide alone.

Using this information, the following suspension was prepared:

1. Prepare as follows:

   a. Two (2) grams pyrimethamine (Daraprim)

   b. Twenty-five (25) grams Ro-4-4393 (Fanzil)

   c. q.s. 835cc water

2. Mark bottle "Shake well immediately before use" as it is a suspension.

3. The dosage of this suspension is 1cc per 3kg body weight for four (4) days out of every week continually throughout the year.

This is a dosage of 10mg/kg Ro-4-4393 (Fanzil) and 0.8mg/kg of pyrimethamine (Daraprim).

Experimental Procedure

In early 1968, there were a total of 24 Humboldt penguins at Sea World. Six of these were treated in the standard manner using Aralen while the remaining 18 were treated with the experimental drug combination.

During the summer months, three of the control group perished from malaria and the remaining three in the control group developed clinical signs of malaria as described above. Subsequent to the death of the third bird in the control group, the three remaining were treated with the new combination. Clinical symptoms disappeared and these three along with the remaining 18 are still symptom-free to this date.

Since the initiation of this treatment, we have had four malarial deaths not including those in the original control group. This occurred during a period when a group of 14 penguins in a breeding colony were accidentally not treated for a period of about one month.

Summary

This data suggests that this drug combination of two grams pyrimethamine (Daraprim) and 25 grams Ro-4-4393 (Fanzil)

is quite efficacious for the control of malaria in the species penguins mentioned. It does not seem to kill the parasite, but rather it does keep it in check. We make this conclusion due to the recurrences observed when the drug is not administered.

The combination has been given continually since May of 1968 without untoward effects suggesting low toxicity on a long-term basis to the animal species treated at indicated dosages.

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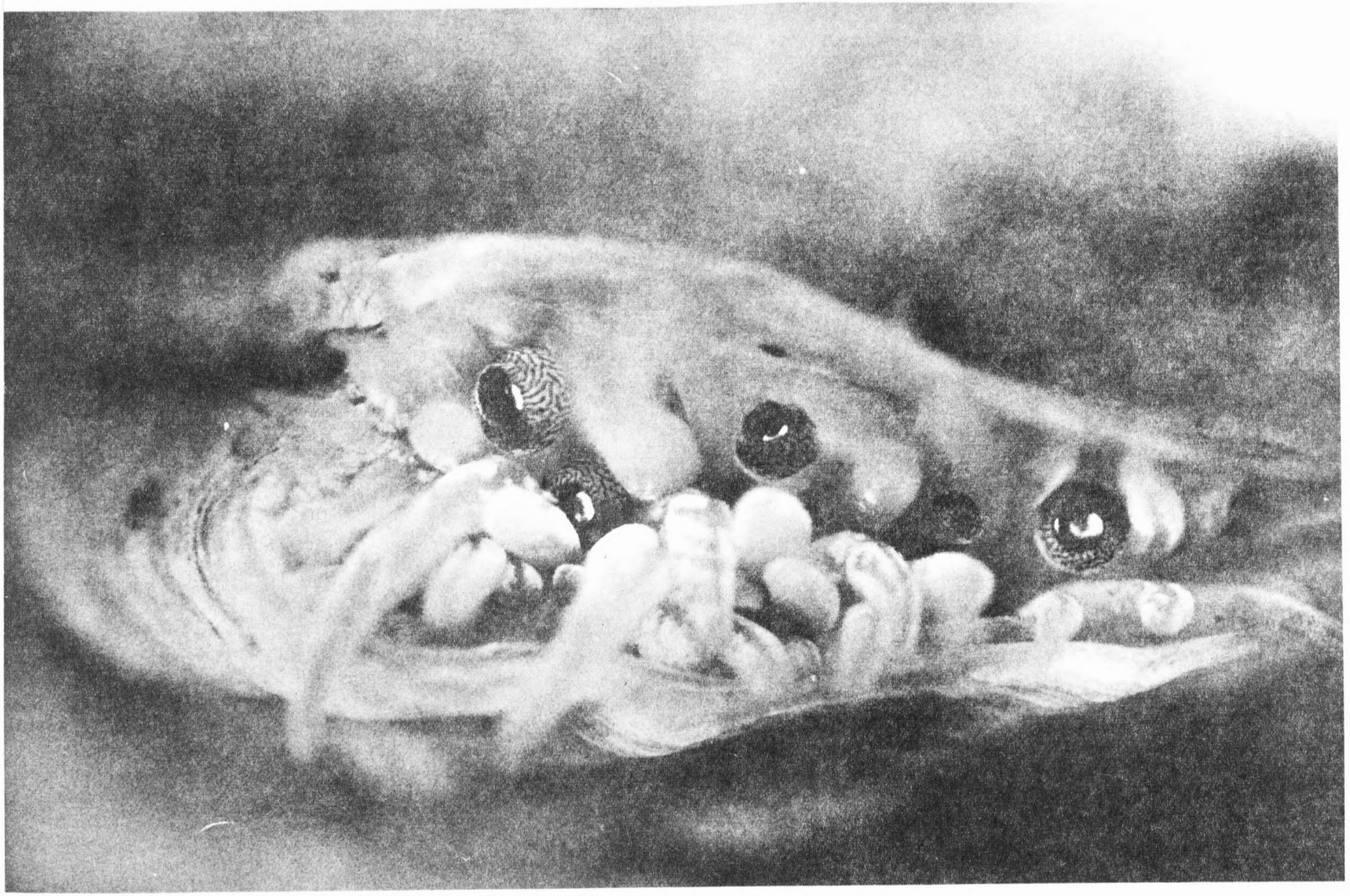
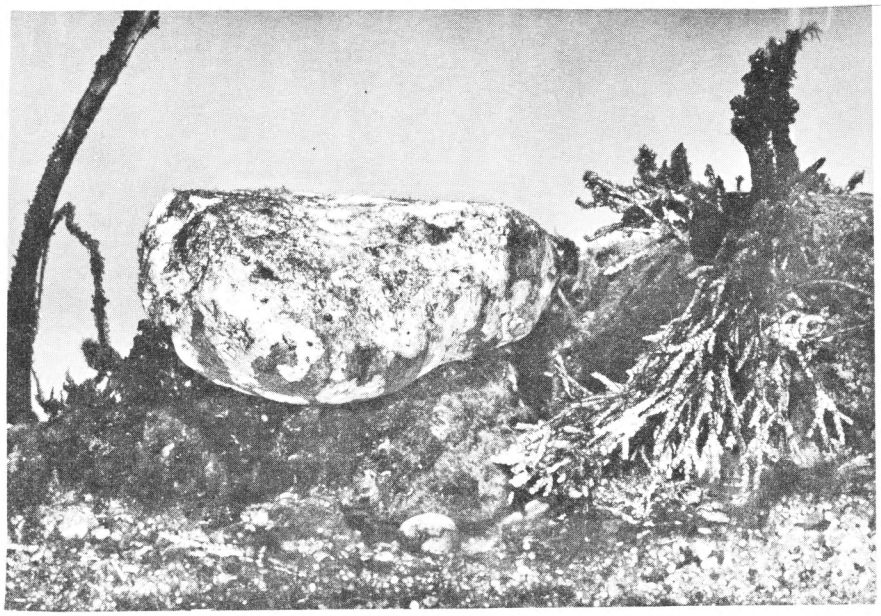
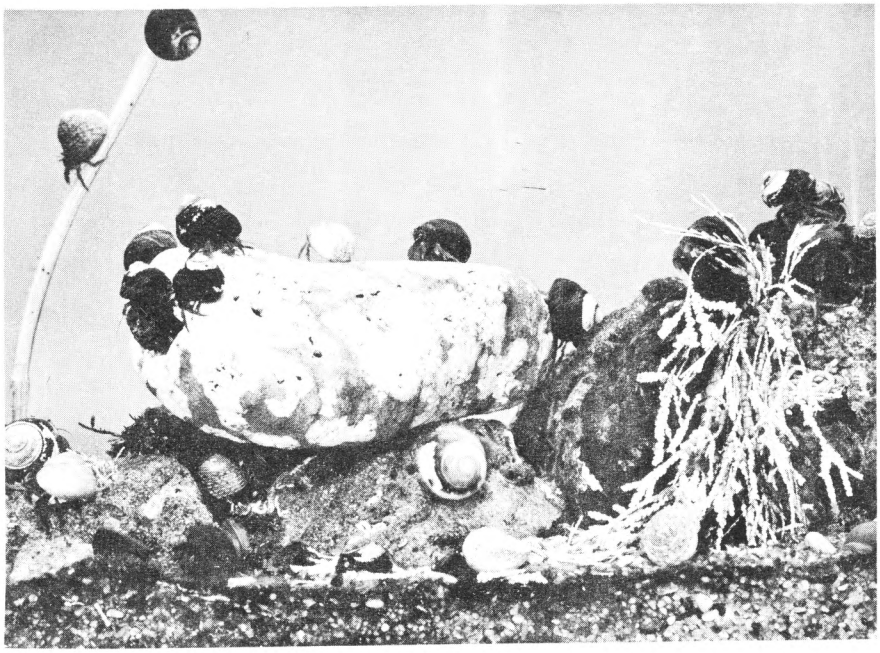
DR. LUIZ SCAFF, Director, Goeldi Museum, Belem, Brazil, visited Washington in March to secure information on aquariums. Their 40-year-old freshwater aquarium has been closed and they plan a replacement. Belem is located at the mouth of the Amazon River from which they will secure specimens.

Scallop Eyes, *Aequipecten aequisalcatus*
(Foto by Charles Eames, 10X)







ALGAE REMOVAL BY HERMIT CRABS

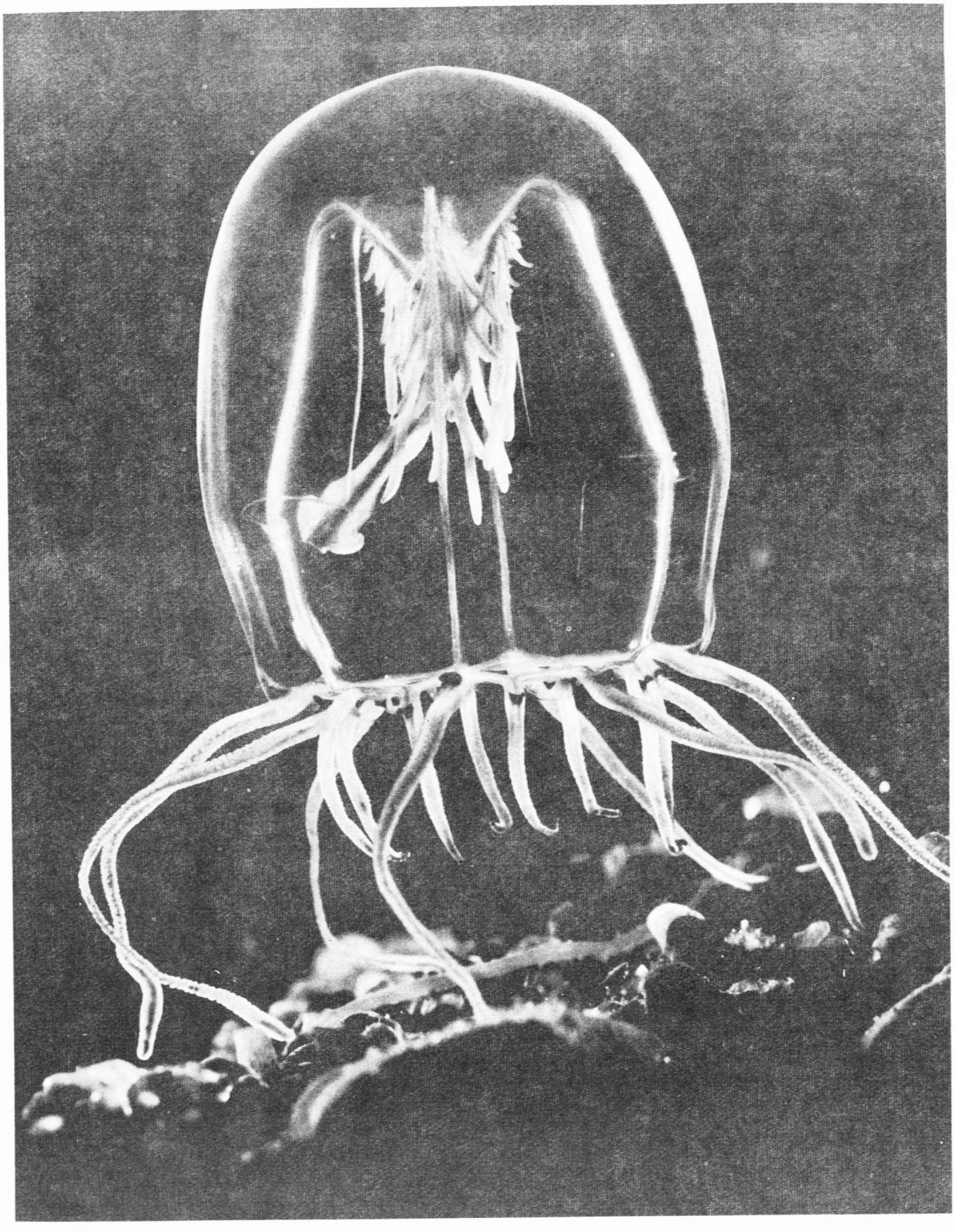
Sam Passalacqua
Office of Charles Eames
Venice, California

Unwanted growth of algae in marine aquaria is a problem that commonly confronts the aquarist. Most authorities advise controlling such growth by "simply" limiting the duration and intensity of light supplied to aquarium tanks. Also most sources adamantly advise against using plants in marine aquaria since among other things algae growth is accelerated.

It has been our experience to disregard the above two rules; the former by necessity and the latter by choice. Our work at the Charles Eames office includes an extensive photographic program of sea life (primarily intertidal animals of the California coast) -- this work requires intense light of lengthy duration. And since we believe the primary objective of an aquarium is that it be ecologically as natural as possible--in a sense a part removed from the whole (in this case the ocean) for education and enjoyment--we do not hesitate to introduce plants and plant-encrusted rocks to our tanks.

Admittedly, algae growth under these circumstances has been a problem; rocks, sand, plants, colonial animals such as coral, any object that provides a suitable substrate is eventually (normally 3-4 weeks) carpeted with an unnatural growth of algae--usually of the brown filamentous variety.

Chemicals have not offered a practical solution, whereas the common Pacific hermit crab, *Paqurus samuelis*, has. Apparently the animal relishes this growth and greedily consumes it, leaving the remaining substrate clean and natural looking. Desirable plants and animals (hydroids, tube worms, etc.) attached to rocks, which would normally be harmed by other attempted methods such as scrubbing, chemicals or using herbivores (all the plants get eaten), are not affected by the crabs.



HYDROMEDUSAN, *Polyorchis haplus*
(Foto by Charles Eames 8x)

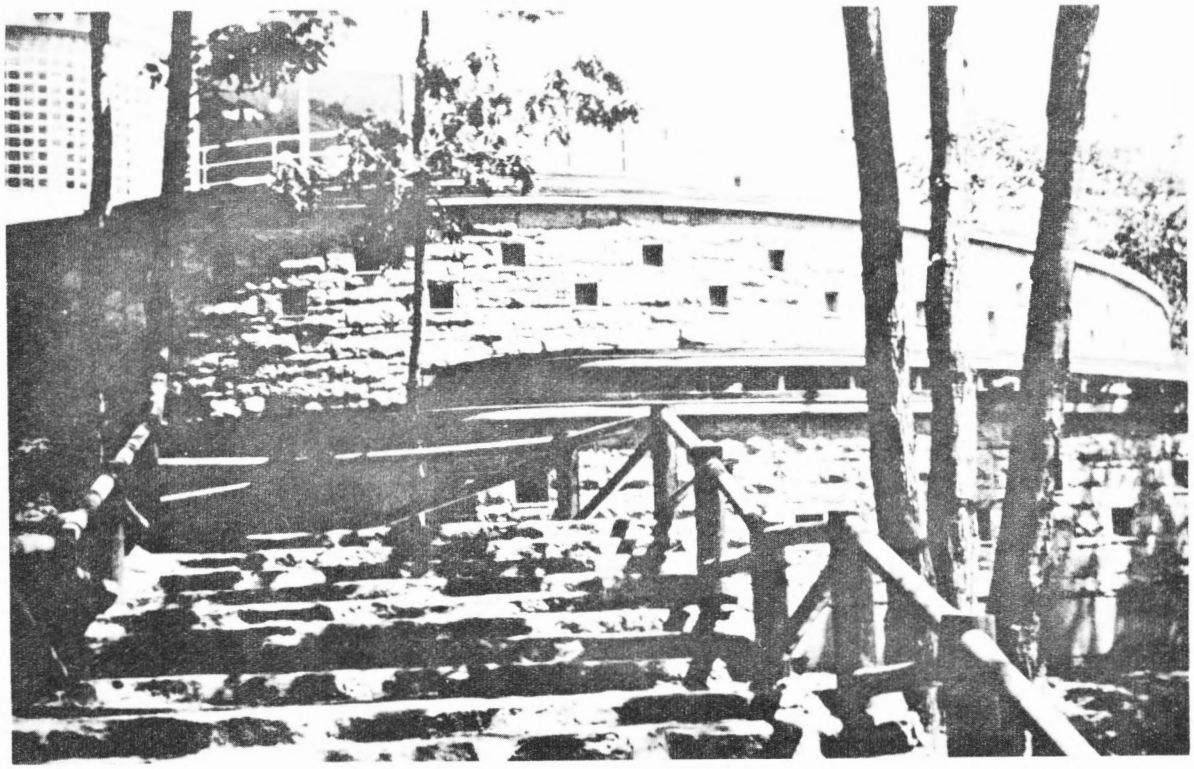
We have one tank that is devoted to hermit crabs and brine shrimp (the crabs eat the dead brine shrimp, keeping the tank from fouling); thus when rocks, etc., get covered with algae we simply place them into this tank for a cleaning. Recently, we have been reversing the process by introducing the crabs into set-up tanks. This has proved to work nicely since resetting the tanks is not always necessary. Removal of the crabs is easily accomplished by hand or by providing a climbing ramp in the tank on which the crabs congregate.

Other arthropods have exhibited this selective eating behavior (amphipods have kept a tank of nudibranchs clean for months), but use of this small hermit crab has proven to be the most practical and efficient.

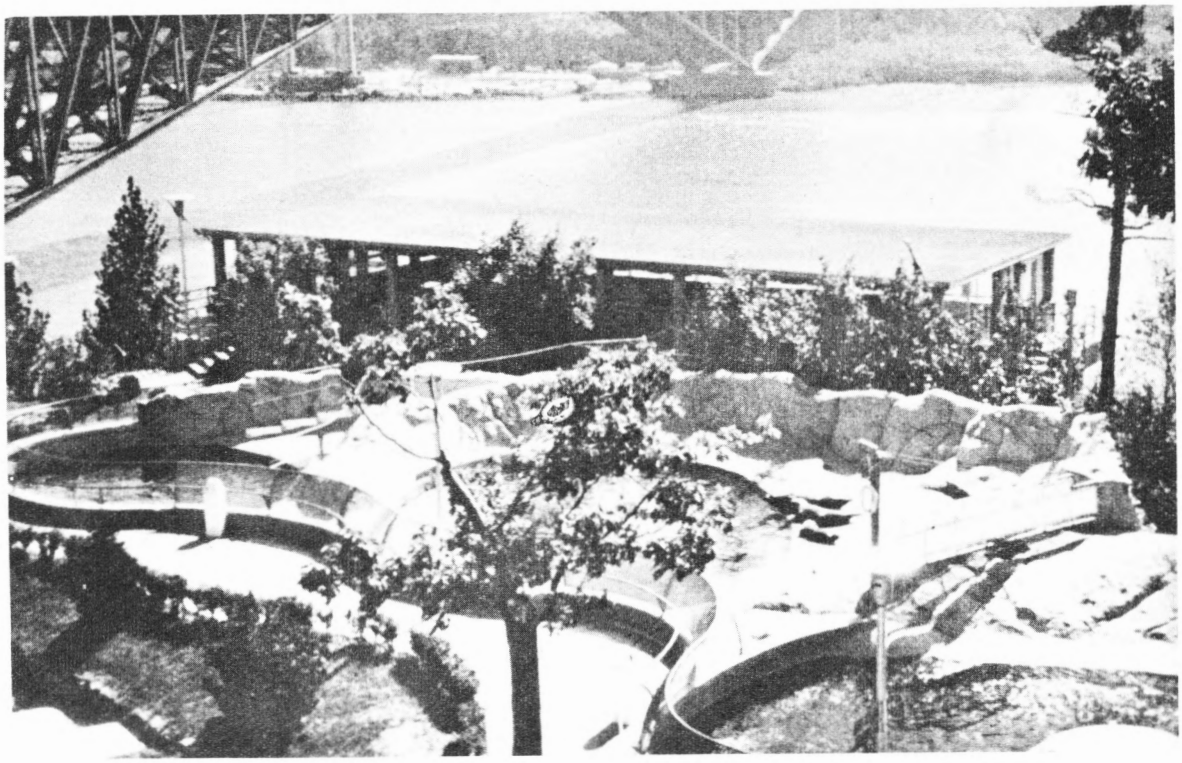
FOTOS BY CHARLES EAMES

Acanthaster planci GOES TO CONGRESS

Hearings were held in March by the Interior and Insular Affairs Committee of the U.S. Senate, to consider programs for the control of the Crown of Thorns--the destroyer of reefs in the Pacific. To provide the Senators with a firsthand look at the culprit the National Aquarium had one of its live specimens on hand for the hearing, complete with coral (not alive).



QUEBEC AQUARIUM ABOVE THE
ST. LAWRENCE RIVER



THE QUEBEC AQUARIUM

Karl-Heinz Krumke
Chief-Technician of
Wildlife
Quebec Aquarium

All travelers using the Transcanada Highway and crossing the majestic St. Lawrence River for a visit to historic Quebec note the Quebec Aquarium on top of a rocky cliff.

The Aquarium is surrounded by a marvelous natural park which lends an air of quiet and undisturbed nature in spite of the nearby highways. The first portion of the structure was built in 1956 by the Provincial government as a biological center. The Aquarium was opened in 1959 to provide the public with greater knowledge of Quebec aquatic fauna.

As the research work of the scientists produced benefits for the Quebec fishermen, the Aquarium more and more became engaged in presenting the unknowns of the aquatic world. The Aquarium has expanded considerably in the last ten years, presenting more species and exhibits, and improving upon our technical installations.

Although the available space in the Aquarium remained the same, we decided to place on exhibit specimens from far away lands and of the seas. We began with ten tanks of 70 gallons each and ten of 10 gallons. These were all placed, together with their equipment, in specially built floor displays. All of these aquaria were made of plexiglass in our own workshop. This material eliminates the troubles one has with saltwater exhibits in metal-framed aquaria. Many of these have been in use for more than seven years. A 3/16" replaceable plastic sheet protects the plexiglass from scratches by visitors.

In recent years we have diverted ten of our large aquaria, 300 to 4,000 gallons, for expansion of the non-native fish exhibits. The remaining 18 tanks from 500 to 4,000 gallons display the fresh- and saltwater aquatic animals of Quebec province. A large number of these specimens have been on display for more than 10 years.

Our reptile collection started when a young boa constrictor, 26 inches in length, arrived in a banana shipment at one of the fruit wholesalers in Quebec in 1963. The space problems in the Aquarium not having improved, we had then to construct moveable terrariums that can be placed wherever space is available. The bottom parts of the moveable terrariums contain the necessary equipment such as ventilators, a filter system for cleaning water, time clocks, and a supplementary heating system for cold winter months controlled by a thermostat. The heating system is quite simple, being ventilator-driven car heaters.

Incidentally, our nice "little" boa has now attained a length of nearly 11 feet and weighs more than 30 pounds. In addition, we now have other boas, pythons, rattlesnakes, and a beautiful cottonmouth and some other snakes from the United States. An alligator held in one of the moveable terrariums outgrew his space and had to be placed in one of our reserve areas.

In 1960 we received some Green Turtle hatchlings from Ascension Island. The largest of these is now 150 pounds and has a carapace length of 31 inches. Its tank of 2,000 gallons is not now quite large enough.

We have added three large outside pools with a total capacity of 60,000 gallons for our seals. At the moment, we have 15 specimens of three species - grey, harp, and harbour seals. Freshwater pumped from the St. Lawrence River, and passed through filters having a daily capacity of 2,000,000 gallons, keeps the seals in running water all year. Subzero temperatures and snowstorms make them the happiest creatures in the world. Plans are in preparation for another 200,000-gallon pool.

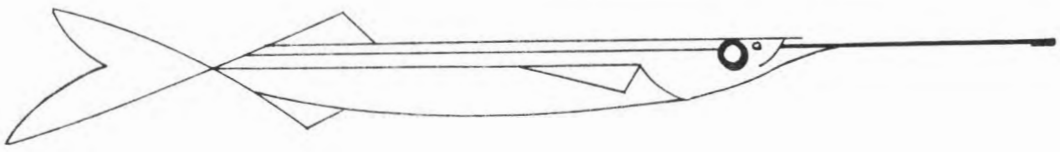
The water supply for the fishes must be brought in by truck, which is equipped with a Goodyear Pillow tank of 2,500 gallons. The freshwater we secure from a nearby lake, while the saltwater comes from the St. Lawrence estuary some 200 miles downstream. The transportation of the saltwater this distance costs us much less than the making of our own artificial sea water.

All of our aquaria from 10 to 4,000 gallons have sub-sand filters. Some of the larger tanks also have an outside filter.

All of our aquaria are on individual closed systems. There are no connections whatsoever between tanks, thus avoiding danger of disease spread. Heat exchange equipment is provided where necessary.

We have our own troubles as do all other aquariums. We are continually struggling to improve by trial and error, through applied research, and by learning of improvements developed elsewhere.

We invite all aquarists who visit Quebec to come see us.



JAMES A. OLIVER will become Director, New York Aquarium, June 1, when ROSS NIGRELLI relinquishes this position to devote full attention to his other position as Director, Osborn Laboratories. Oliver served for ten years as Director, American Museum of Natural History, and prior to that was Director of the Bronx Zoo, following service as Curator of Reptiles at the Zoo.

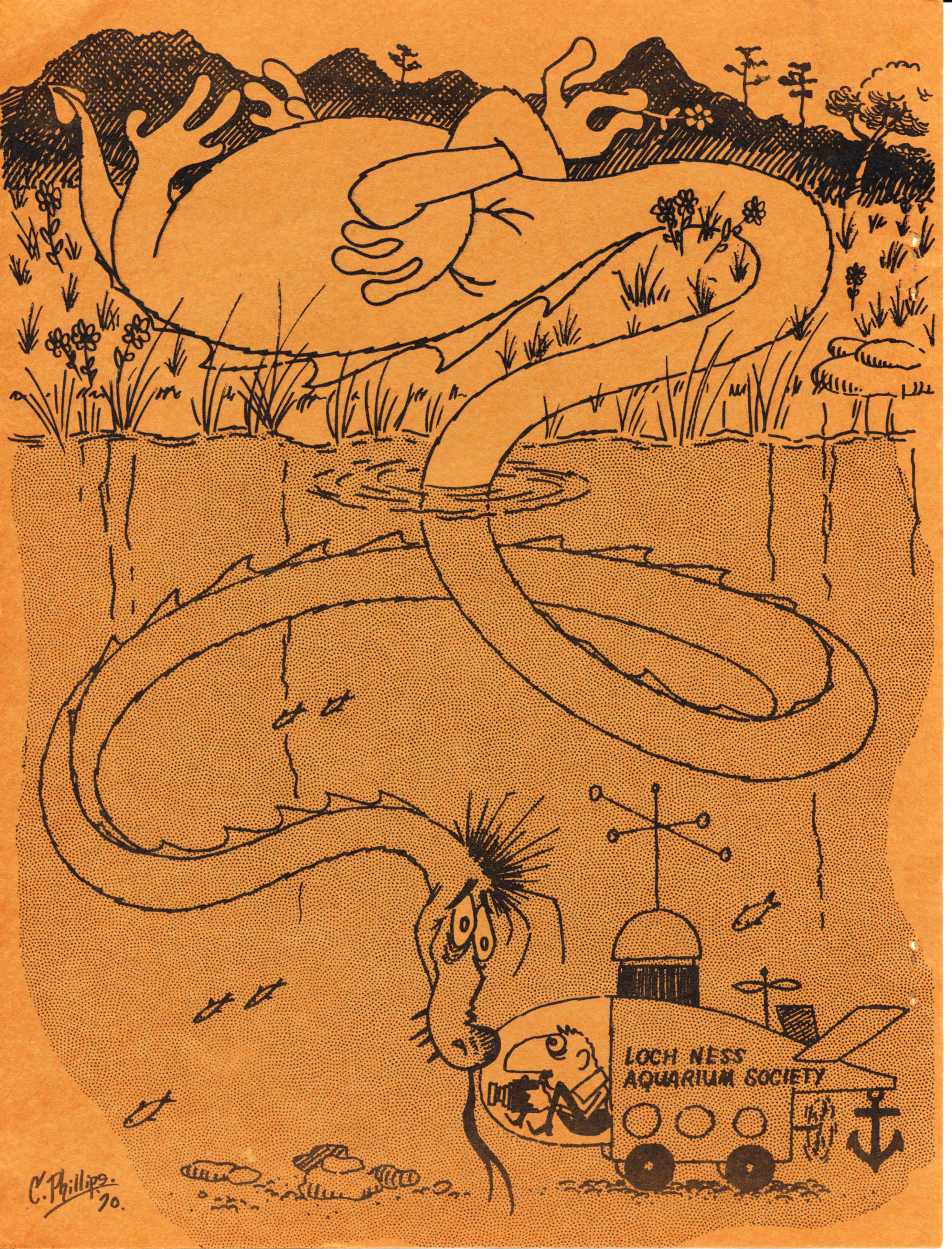
MORE ON ADHESIVE/SEALANTS

In the January 1968 issue of DRUM AND CROAKER, WALTER L. WEST and PHILIP A. BUTLER reported on the "Mechanical Testing and Bioassay of Adhesive/Sealants." Included was the testing of materials to seal hairline cracks on the water surface of concrete tanks.

We now have an April 1970 report from Hatchery Manager DON E. CULBERTSON in which he makes further report of applications on a concrete trout raceway at Pisgah Forest, North Carolina.

> *"Two areas, each 30" x 30", were painted with Devon Epoxy in December 1966. One was epoxy over raw concrete; the other area was etched with muriatic acid, washed and dried, before epoxy was applied.*
>
> *"The two areas of epoxy are still in good shape, with no cracking evident, no peeling, and with adhesion still excellent."*

BILL FLYNN, Curator, Pittsburgh AquaZoo, advises that Senior Aquarist, JIM KEPLEY has left to accept the position of Curator of the new Aquarium of Cape Cod, West Yarmouth, Massachusetts.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