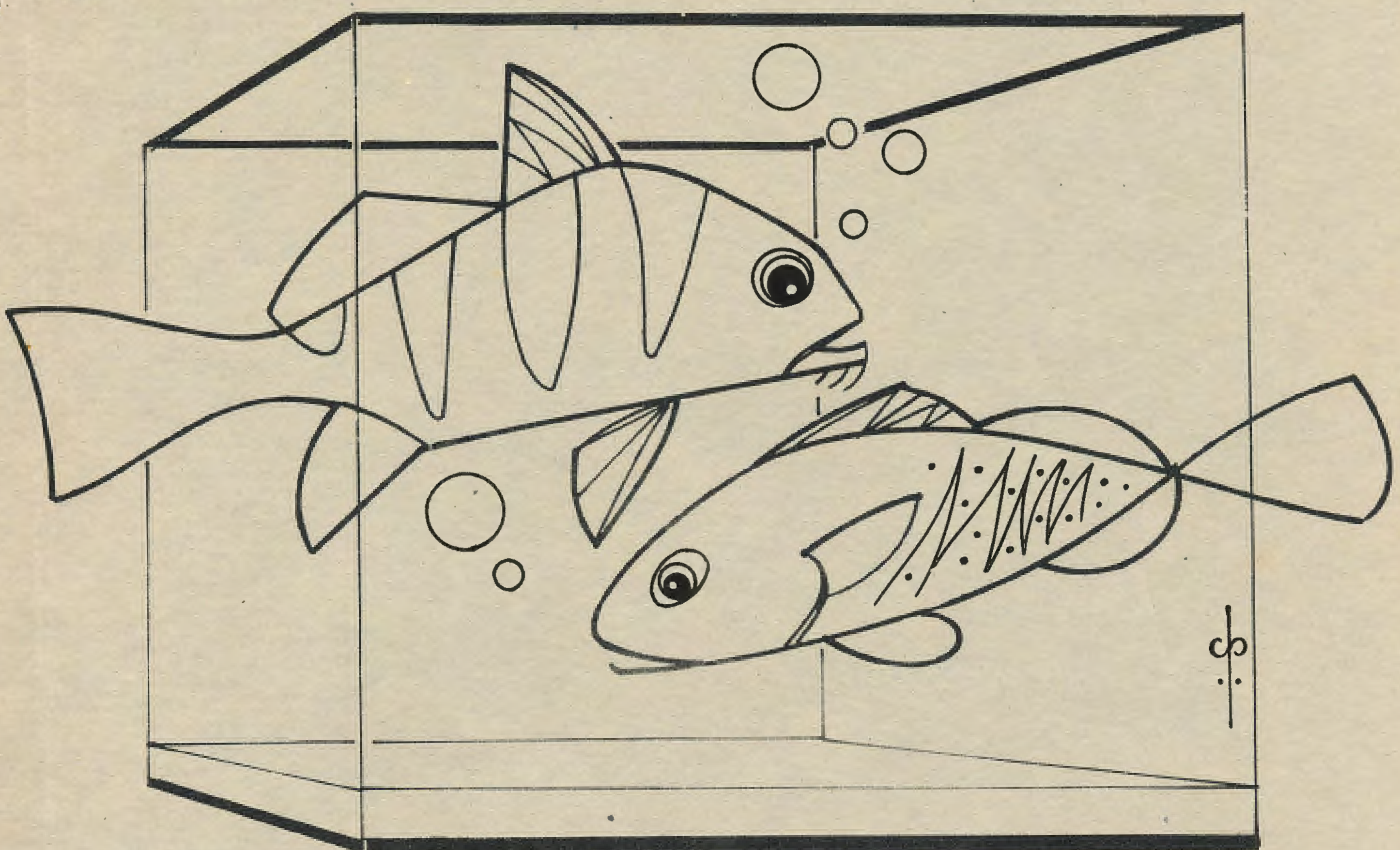
DRUM and CROAKER



VOLUME LXIX, NUMBER 1 JANUARY 1969

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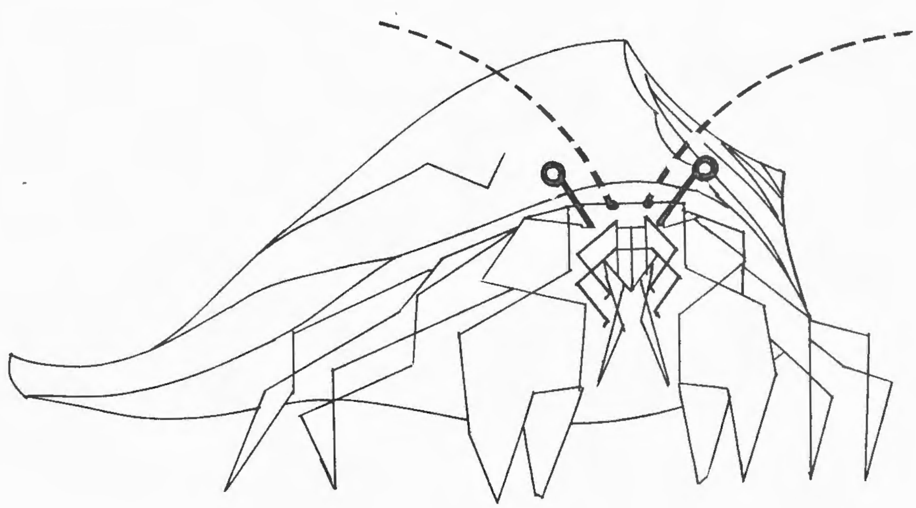

VOLUME LXIX, NUMBER 1 JANUARY 1969

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

The Informal Organ

of the

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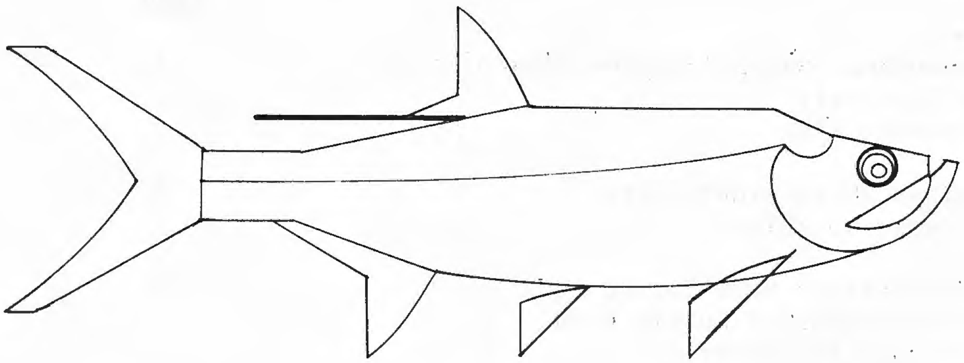
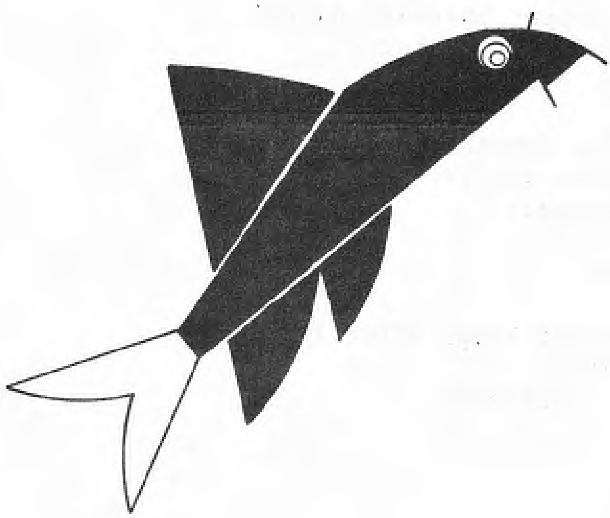
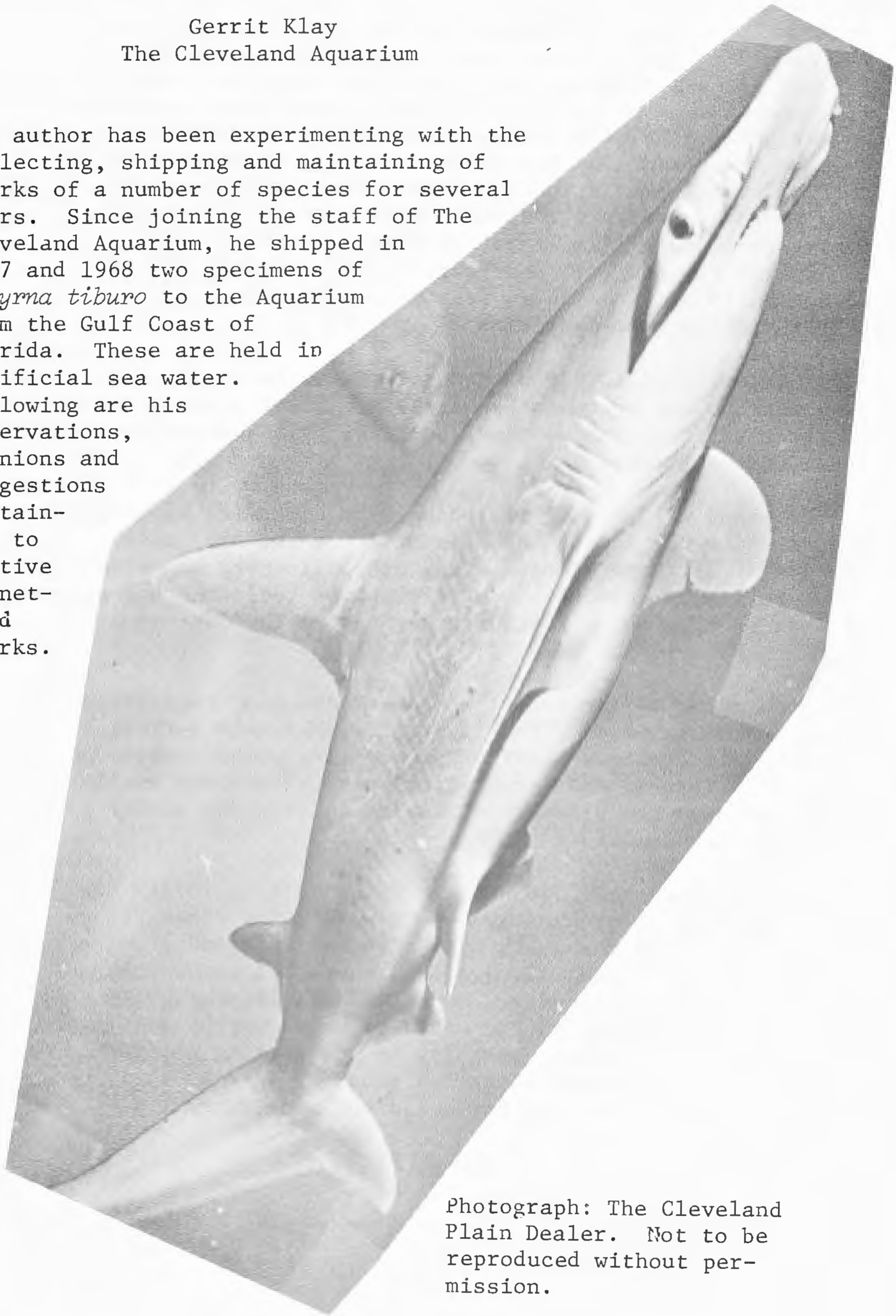




BONNETHEAD SHARK *(Sphyrna tiburo)* IN CAPTIVITY

Gerrit Klay
The Cleveland Aquarium

The author has been experimenting with the collecting, shipping and maintaining of sharks of a number of species for several years. Since joining the staff of The Cleveland Aquarium, he shipped in 1967 and 1968 two specimens of *Sphyrna tiburo* to the Aquarium from the Gulf Coast of Florida. These are held in artificial sea water. Following are his observations, opinions and suggestions pertaining to captive bonnethead sharks.



Photograph: The Cleveland Plain Dealer. Not to be reproduced without permission.

A newly obtained bonnethead shark should be handled with extreme care. A pH difference between shipping container and tank is almost sure to throw the animal into shock. A round plastic swimming pool about nine feet in diameter will accommodate an adult bonnethead. When first introduced in the pool, some will swim from the start and others will rest on the bottom for a short while. I have found "walking" the shark will put it in worse condition. When the shark is allowed to rest undisturbed on the bottom, it usually starts swimming by itself before long. After a couple of days in the pool, it can be released on display if in good condition. (Continued resting on the bottom of the pool indicates poor condition.)

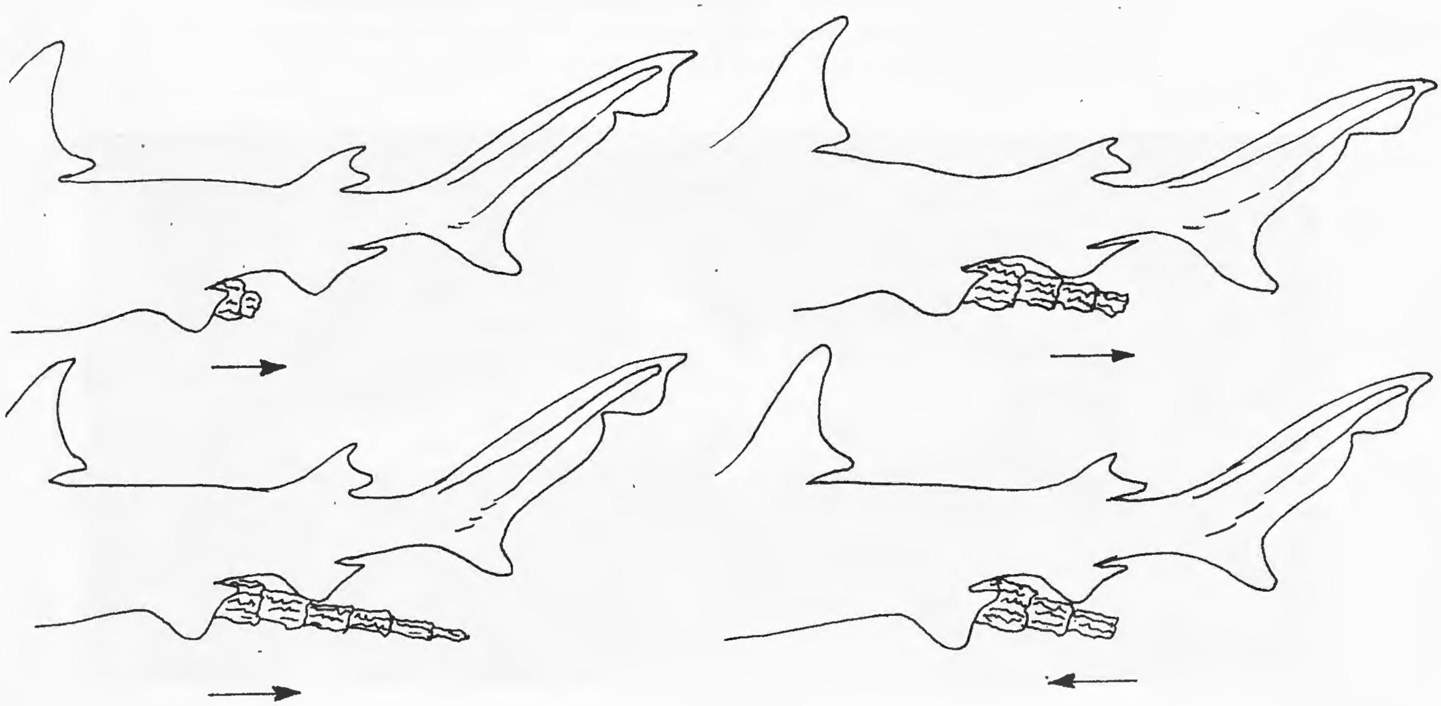
Light intensities should be reduced, as bonnetheads are very nervous and prone to light shock. After being conditioned to its artificial environment, however, this species becomes relatively tolerant.

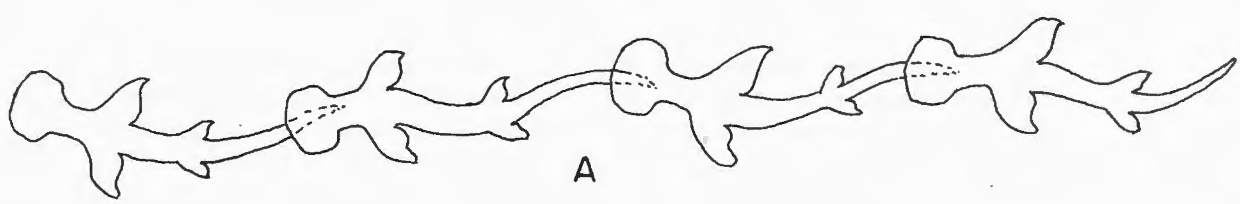
A bonnethead will adjust very nicely to captivity if handled properly when collected and shipped. I never used anesthetics of any kind except during my preliminary experiments. For some reason unknown to me, the sharks collected and shipped with drugs seem to be retarded compared to the ones on which drugs were not used.

The body color of the bonnethead shark changes frequently, depending on its mood, from light gray to almost dusky brown. Color changes occur on smaller individuals more frequently than in the larger specimens. There are small black spots on the sides which differ in size and number in each individual.

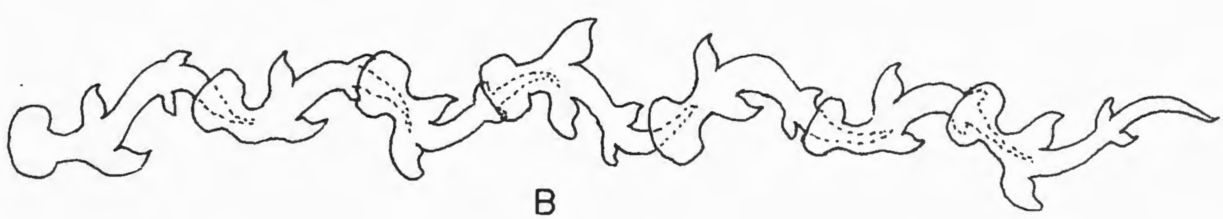
Our larger bonnethead (36") seems to be vicious in its habits. It killed a 24" cow-nose ray and damaged a few other fishes which were in its tank. It also attacked a friend of mine and me while we were guiding a bull shark. I was bitten on one toe and bled copiously. My friend was attacked four times. He was bitten in the underarm, once on the neck and once on his face plate. Luckily, he was wearing a wet-suit jacket, which was shredded at the points of attack, but through which the shark's teeth did not penetrate.

About once a month, for each of our bonnetheads, I have observed what was at first an alarming habit. What appears to be the gut is extruded, inside-out, from the anus, and extends back as far as the lower caudal lobe. During a period of from four to five seconds, the shark's body vibrates and the normal swimming undulations (fig. A) become exaggerated (fig. B). During this interval of snake-like swimming and vibration, small particles are seen to fly off the gut lobes, after which time the gut is retracted, and normal swimming resumes.





A



B

The Cleveland Aquarium's two bonnetheads measure 36" and 24". These sharks currently share a hexagonal tank (6,500 gallons) with one three-foot lemon shark and a nurse shark of similar length. There are also two smaller groupers in this tank. The nurse shark rests on the bottom most of the time. The lemon shark habitually uses the bottom half of the tank. The smaller bonnethead occupies the bottom 2/3, while the larger uses the top 1/3. Only during feeding do they ordinarily intrude in each others territory. When undisturbed, they swim in large circles, sometimes at high speed, close to the walls, changing direction rarely, except when startled by visitors.

The larger of the two bonnetheads will, when panicked, "hydroplane" near the surface with all of its head out of the water, yet still avoiding the walls.

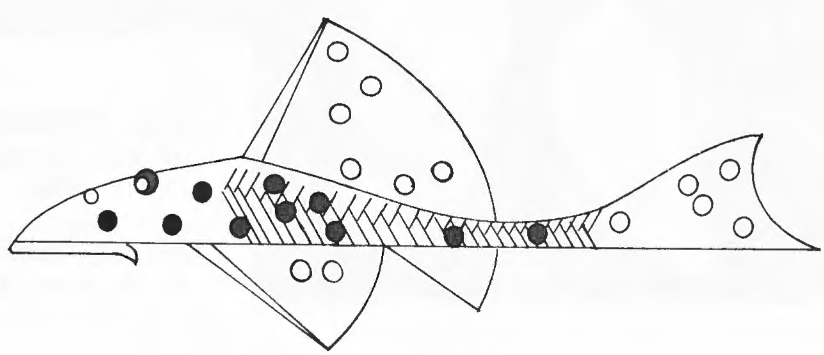
For the first two or three weeks after being in captivity, bonnetheads may refuse food. Eventually they will almost invariably show interest and then begin feeding voluntarily. After the shark eats its first piece of cut shrimp or smelt it can be expected to eat readily. Much individual variation is to be seen among bonnetheads in this aspect. Whole smelt which float will often be bumped first, and eaten on the second pass. Smaller pieces will generally be swallowed without hesitation before reaching the bottom. When a large amount of food is dropped into the tank the shark will follow the smelt down, swimming in circles and swallowing a piece at a time. Once a week we add a multiple vitamin capsule to the cut fish. A small amount of shrimp is fed as a supplement to the smelt. Live goldfish have been offered, but never taken by the bonnetheads.

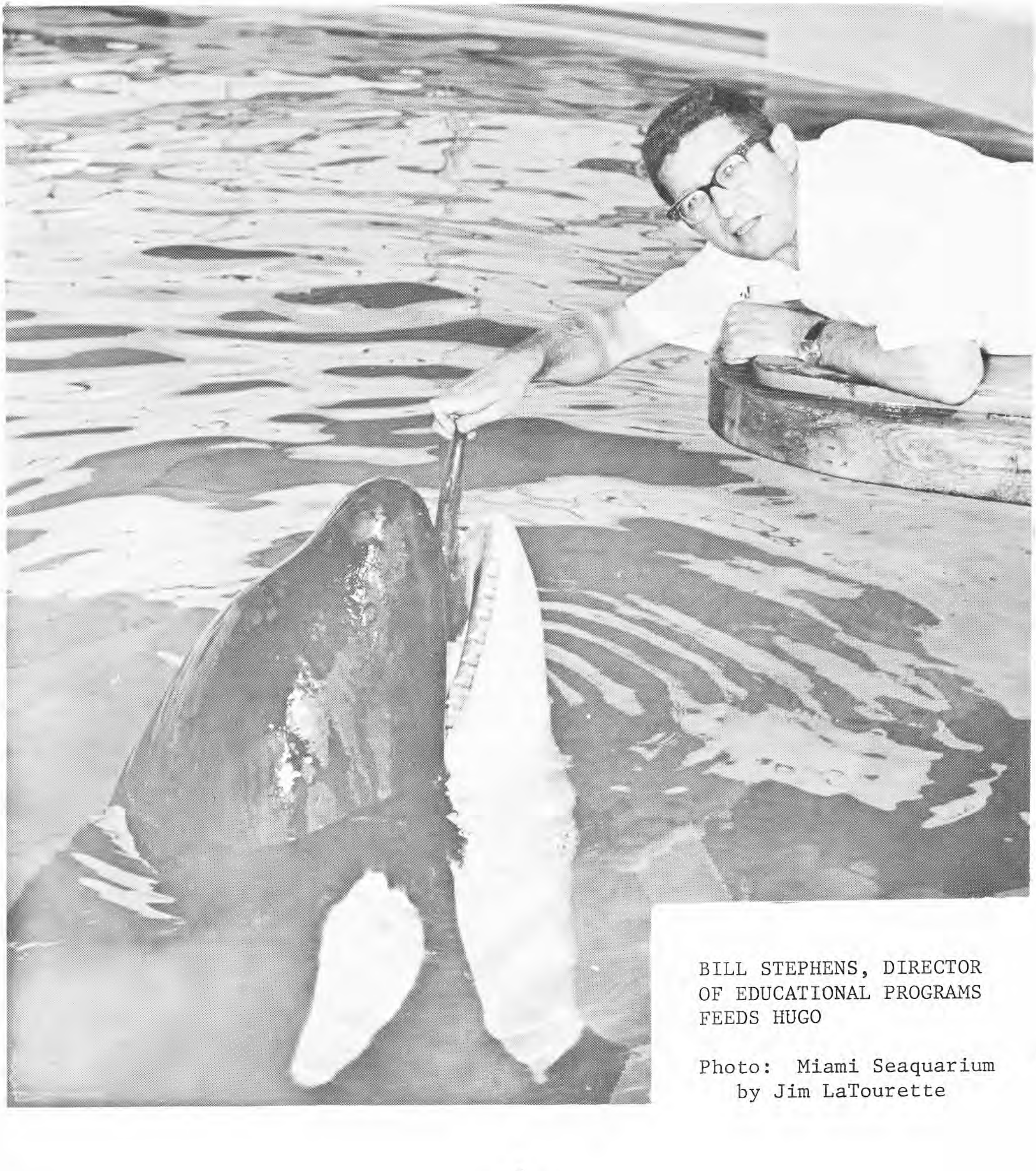
One of the most common injuries results from bumping the snout on the tank wall as a result of pounding on the glass by visitors. These injuries will usually heal in a relatively short time. Bad bruises show up on rare occasions--with our sharks only once. Treatment: Leave the shark where it is. If it still eats, add Vitamin C (100 mg. tablets) to its daily food to help the blood clot. The bruise should close up within two weeks.

Severe bruises are first noticeable when the underside of the bonnethead turns red, after which part of the bonnet starts deteriorating and the bare cartilage shows. For this we use the same addition of Vitamin C in the daily food.

Perhaps as a result of a common trace element difficiency and the lack of iodine in some artificial sea waters some sharks develop a goiter under the jaw which will grow and sometimes develop into a bloody ulcer. Iodine is added to the food or placed in the water as part of a trace element supplement which we add to the water once a month. So far, our bonnetheads apparently have a normal thyroid glands.

It has been my experience that bonnethead sharks kept in cooper-treated water do not long survive.





BILL STEPHENS, DIRECTOR
OF EDUCATIONAL PROGRAMS
FEEDS HUGO

Photo: Miami Seaquarium
by Jim LaTourette

KILLER WHALE GROWTH DATA

Jesse R. White, D.V.M.
Staff Veterinarian
Miami Seaquarium

Hugo was captured February 22, 1968, (Ed: See D&C Sept. 1968, p. 17) off the Pacific coast near the town of Vaughn, Washington. He was 398.8 cm (13 feet, 1 inch) in length and weighed 873.15 kilograms (1921 lbs.). Upon arrival at the Miami Seaquarium, the whale was 411.48 cm long (13 feet, 6 inches). These and subsequent measurements are given below.

TABLE I

Date	Length* cm	Weight kilograms	Girth** cm
2/22/68	398.8	873.15	-----
5/15/68	411.48	------	-----
10/10/68	459.74	-------	-----
12/10/68	467.36	1309.0	269.24
% Increase	14.6%	33.2%	------

*from tip of snout to notch of caudal fluke
**just anterior to dorsal fin

It is obvious that the whale has adjusted to captivity quite well. In the absence of vigorous exercise, he has also increased in weight considerably.

Hugo has an average intake of 90-100 lbs. of fish per day, consisting of 80-90% Atlantic herring, (*Clupea harengus*) and 10-20% blue runner, (*Caranx crysos*).

The whale's over-all health is excellent. This shall continue to be monitored by routine blood tests every three months. In addition to the routine blood analysis, some blood chemical values were determined to ascertain the state of nutrition. Bacteriological tests are also conducted, the results of which have been negative for pathogens.

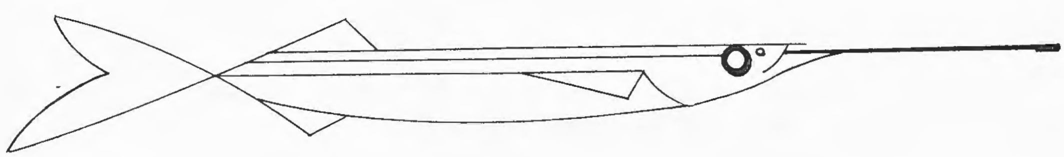
TABLE II

RESULTS OF BLOOD TEST

KILLER WHALE

Test	Values Found	Assumed Normals*
RBC	4,750,000/mm^3	4-6million/mm^3
WBC	7,050/mm^3	6-10 thou./mm^3
Hematocrit	47 vols.%	40-50 vols.%
Hemoglobin	17 gms.%	16-19 gms%
B.U.N. (D)	0.07 mgm.%	Less than .1 mgm.%
Total protein	5.5 gm.%	6.0-7.8 gm.%
Blood glucose	154 mg.%	100-190 mg.%
Cholesterol	316 mgm.%	230-300 mgm.%

*Normals are not clearly established in most blood work.
These data were obtained from Dr. G. W. Klontz.



RICHARD VAHAN, formerly Curator of Collections, New England Aquarium, Boston, is now Curator of Education at Shedd Aquarium, Chicago (as of December 1). Also, DAVID MILLER, Curator of Fishes NEA has left that institution.

Minutes of the Society of Friends of Natural Science Research
in Berlin

N.F. Volume VI, 1966, pp. 101-107

OBSERVATIONS MADE DURING THE BREEDING OF CUTTLE FISH[1]
(Sepia officinalis L.)

Werner Schroeder
Director, Berlin Aquarium

In art and literature cuttlefish have been mentioned for thousands of years. Since Schneider (1784), who grouped *sepia, loligo,* etc. into a separate class *(Cephalopoda)* within the species of mollusks, there is no doubt about their classification in the system. From the morphological and physiological point of view, the cephalopods are among the most highly developed of the lower animals. Their psychic impulses and their degree of intelligence are of exceptional importance.

Even today, cuttle fish are surrounded by legends, and it is surprising that such interesting and notable animals can be seen in aquaria only rarely. The species which are best suited for aquaria, such as *sepia, octopus, eledone* and *loligo,* are generally considered difficult and short-lived. On the grounds of long years of personal experience in keeping and breeding *Sepia officinalis,* cuttle fishes can, however, be recommended for behavioral studies as relatively long-lived animals and as objects especially suitable for observation.

At the end of April 1965, the Berlin aquarium received an 18 cm *Sepia* which had been caught two days earlier on the northern coast of Sicily. The animal, which had arrived without injuries, was put in a display tank holding 4,500 liters and was kept in artificially prepared sea water of a density of 1,025 and at a temperature of 20°C.

The second day we found more than 100 dark-grey eggs on a celluoid areation pipe. In comparison to those of the octopus, these eggs are enormous (up to 12 x 20 mm, weight 2 - 2.5 g) and are covered by a multilayered elastic shell (Fig. 1). The first young animals hatched seven days later. The time of hatching varied greatly, the last animals only hatched after 3 months.

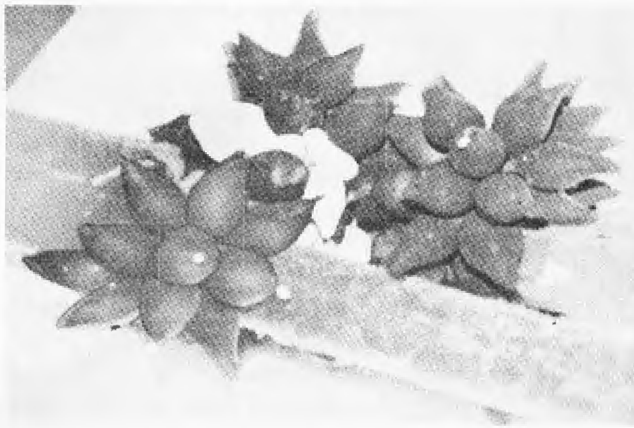


Figure 1

At hatching the young light-grey sepias are 7 to 8 mm long. Their shape is rounder than that of older specimens and their movements are not yet of perfect "elegance" since their fins are not yet completely developed.

In the beginning, their funnel which can be folded back, seems to be the main instrument of locomotion. For the most part, the young *sepias* lived buried in sand up to their eyes which are located on top of their heads. After they were able to perceive their prey - sense of touch and chemical reception are of secondary importance - they captured daphnias and even relatively big prawns *(Praunus flexuosus)* showing great accuracy with their extensible pair of tentacles. This spearing of the prey is very similar to the way the Chameleon feeds using his tongue to execute the same function (Fig. 2).

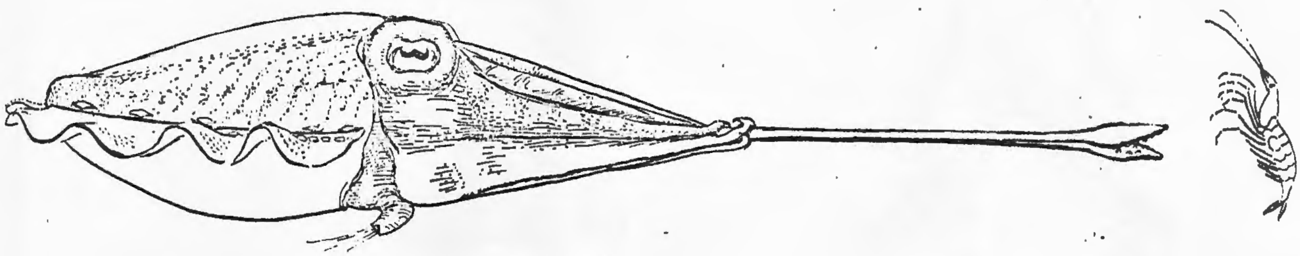


Figure 2

Shortly after hatching the sepias are able to change color. When alarmed, they immediately turn black and usually tend to eject their ink-like secretion. The very common conception according to which cuttle fish purposely envelop themselves in a "cloud of ink" when in danger is hardly confirmed. Observations of larger animals in aquaria, as well as findings on the Mediterranean coast, showed that the amount of secretion would not be sufficient for camouflage, but would suffice to distract or frighten the enemy.

The maturing sepias in our display tank showed a noticeable adaptation of color to the environment. Animals resting on sand are almost always light-grey, whereas individuals lying on rock ledges are always of variable dark-brown color thus blending in with the color of the brown algae growing there. Beside this change of color, which is of mimetic nature, our sepias also showed relatively frequently distinct color patterns in the pigmentation of their top surface. The typical zebra stripe pattern (Fig. 3) of the *Sepia officinalis* was never observed on the very young animals. Only as they grow it becomes more and more frequent; fully grown specimens, especially males, almost invariably have a striped pattern. Young animals often have shown a marbled coloring on the upper side of their bodies which is good camouflage (Fig. 4). More rarely and only for a shorter period of time an escutcheon-like pattern, which looks like a signal, is formed. Another pigmentation effect which is very striking is the simultaneous heightening of their tint and appearance of a pair of dark round spots on the rear half of their backs. This color pattern reminds one of the marcation of eyes on some insects, fishes and birds. According to our observations, this is also a threatening and defense reaction.

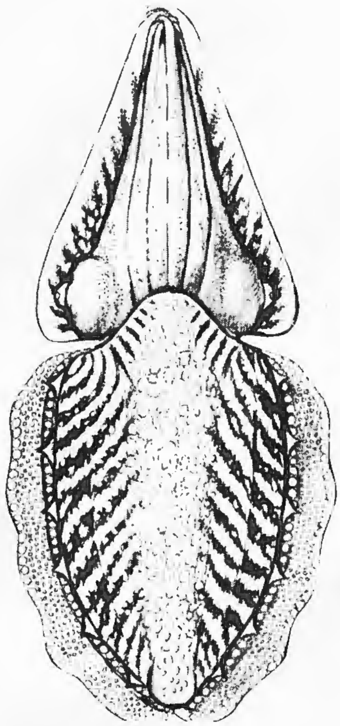


Figure 3

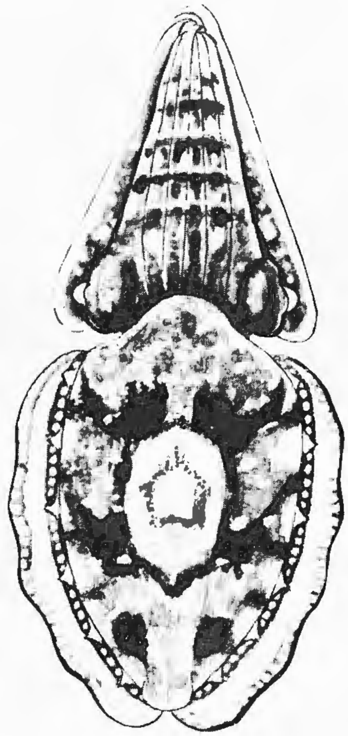


Figure 4

The tending and breeding of *Sepia officinalis* up to the third generation which we were the first to achieve, led to findings which were partially unknown and which are probably of interest beyond the field of aquarium science. The young animals which were fed twice a day with live prawns of the species *Paraunus, Leander* and *Crangon* as well as with *Gammarus* developed very well. They assume the shape and manner of swimming typical of adult sepias after 6 to 8 weeks, when they have reached a length of approximately 3 cm. After 5 months, the largest among them had a length of 8 cm. At that point we could occasionally let them feed on sticklebacks and crabs *(Carcinus)* the size of a 25-cent coin. The sepias circled the armed crab with precaution and skill in order to attack them from the rear, outside the range of their claws. For the most part, fish and prawns were eaten whole, whereas the crabs, which have a harder shell, were pierced and sipped with the parrot-like beak. On several occasions, we observed that sepias which had approached too big a prey got frightened and secreted ink. Repeatedly this started a panic-like chain reaction with the other animals which completely darkened the tank for hours.

Eight months after hatching, our sepias had reached a length of 12 to 15 cm. Occasional restlessness announced the beginning of their sexual maturity. They often confronted each other in a threatening position with their first pair of tentacles standing out like antlers; several times also the second tentacle pair was raised which apparently was a sign of particularly strong excitement (Fig. 5). We occasionally found slightly injured animals with impressions of acetabula on their surface. Two weeks later, we observed the first coupling attempt of an almost 20 cm male. The males are generally bigger,

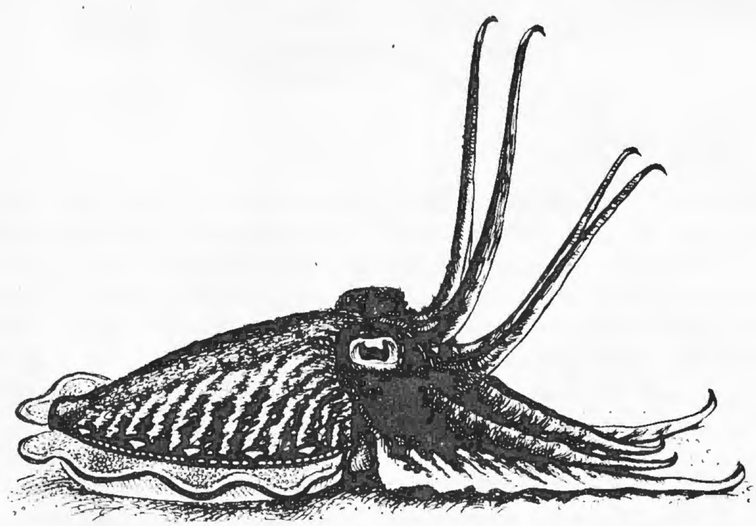


Figure 5

of brighter colors and have a distinctly white fringe of fins. During the period of sexual excitement, their zebra pattern becomes more intensive, their eyes are even more protruding and the body skin above the eyes is of a bright green color. The male ready for pairing swam very excitedly next to or closely behind the female. After extended persecution he lay very closely to his partner on a level spot of the tank with his tentacles raised like stilts, heavily breathing and fanning with his fringe of fins, and tenderly carassing with his tentacles her head and the upper side of her body.

A short time later, he pushed the female harshly against the wall of the tank, whereupon she suddenly spread out her tentacles like a star. The male took advantage of this moment and they paired in like manner, head to head (Fig. 6). The copulation lasted for almost 3 minutes and took place in jerky movements. After a pause of several minutes another somewhat shorter copulation took place and after a longer pause a third one of only a minute.

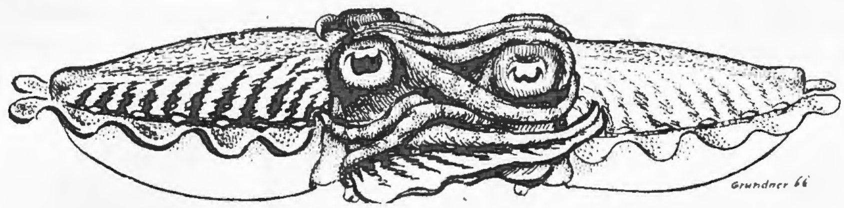


Figure 6

At the end of February 1966, repeated pairing and egg laying took place among the 73 sepias of the first new generation which then had an average length of 20 cm. On February 23, at 8:00 a.m., a pair was found in copulation on a fresh spawn of approximately 20 eggs. After copulation the female swam about the tank, closely followed by the male, and returned to the spawn. In the course of half an hour further copulations of short duration took place.

In between the copulations, the first eggs were laid. When leaving the funnel, the eggs were siezed by the tentacles and with great care were individually attached to the celluloid pipes by means of gelatinous filaments within 2 to 3 seconds (Fig. 7). The spawning time amounted to more than 4 hours with several major pauses; a total of more than 100 eggs were laid for the most part at intervals of 2 to 3 minutes.

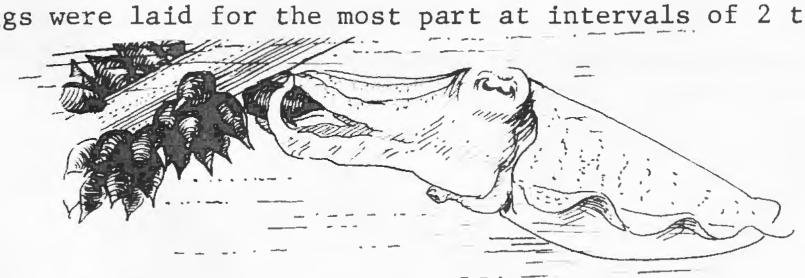


Figure 7

Up to now, we have not had any exact data on the life span of *Sepia officinalis*. According to S.G.A. Jackel (1958) the animals die shortly after reproduction, and live anyhow only a few months in captivity. On our animals, particularly on the male specimens, we could establish that they can stay alive for many months after pairing. Our new generation of the F1 was still in best health at the age of 10 months. After that time only, a gradual degeneration set in which could be noticed by the poor regeneration of abrasion wounds on the rear end of the cuttlebone. After 14 months all but three animals had died; the three are still alive at the time this report is written. Our largest animals of the new generation attained a weight of almost 700 g at a length of 24 cm. The maximum length of the cuttlebone was 17 cm.

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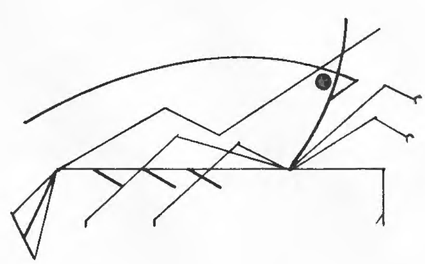
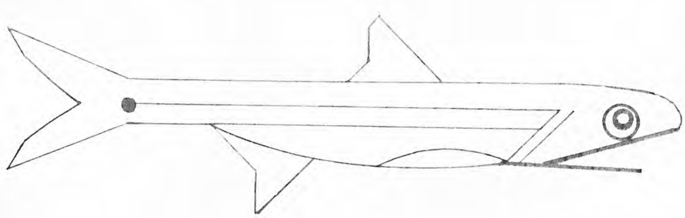
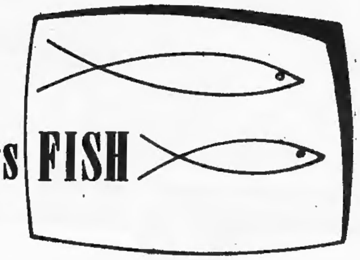


Earl Herald acts as "seeing eye" for blind river dolphin "Susu" (Platanista gangetica) which he collected from the Indus River in western Pakistan. (See story in January 1969 issue of ANCHOR, the San Francisco Aquarium Society Newsletter.)



DON'T FORGET to budget for the June 1969 ASIH meeting in New York. Details later.

TV Show Stars FISH



The stars on two television screens located at the Bureau of Reclamation's Red Bluff Diversion Dam across the Sacramento River, California, are all fish -- salmon, steelhead and rainbow trout, shad, striped bass, squawfish, suckers, and other rough fish, plus the eel-like lamprey.

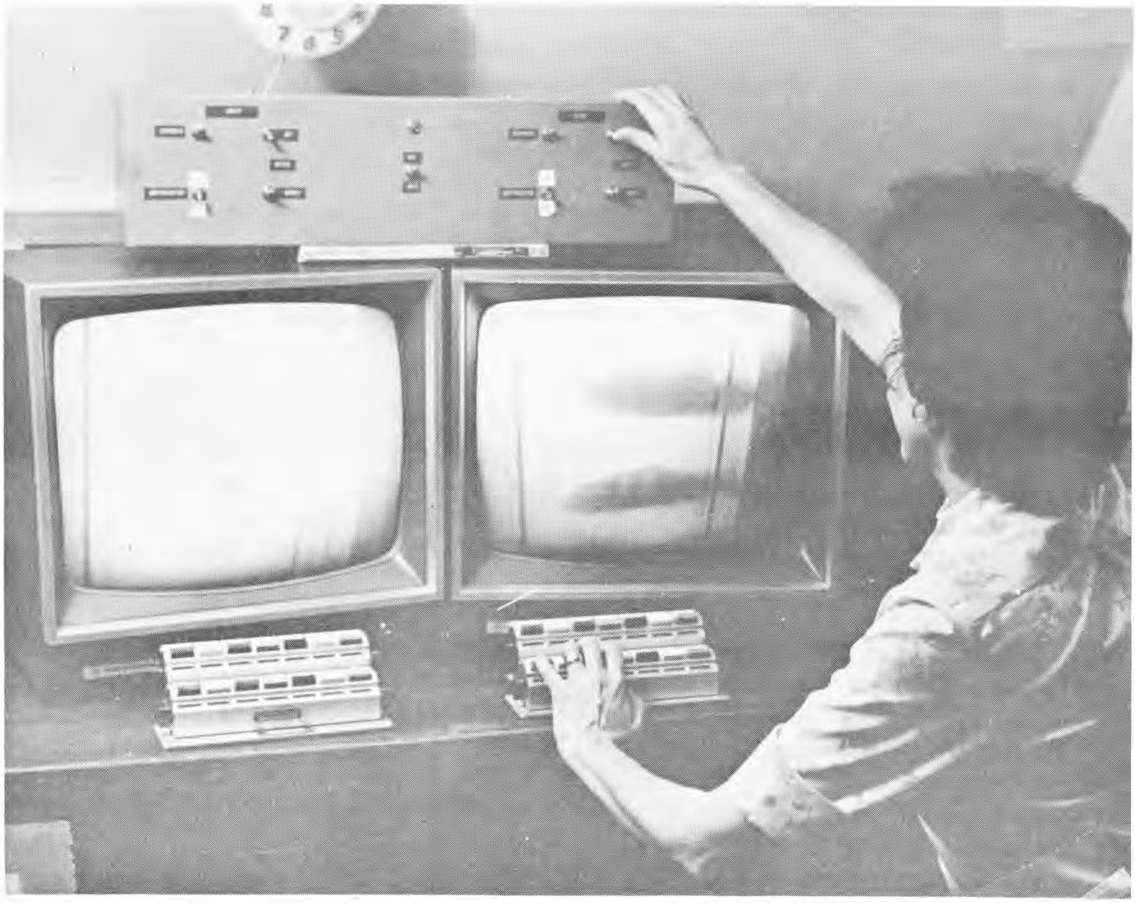
The Bureau of Sport Fisheries and Wildlife catches their image on the two TV cameras of a closed-circuit system as they pass through a lighted, specially designed viewing chamber at the head of each fish ladder.

Most of these fish are on the way upstream to spawn, but some go back and forth several times through the viewing chamber before completing their final trip.

In the approximately one-fifth of a second an image appears on either screen, a trained observed identifies the species, tallies it on pushbutton counters, and enters the information hour by hour on a log book. The screens are watched 16 hours a day 7 days a week.

A few night counts are planned as the movements of the fish during the hours of darkness are unknown.

The facility is reported as the only one in the world where fish are counted by television. The Bureau contemplates adding a video tape system, hopefully in color, which can be run unattended and viewed the next day. The tape could also be shown to the public in a visitation center planned for the recreation area to be developed at the dam.



An additional feature now in the experimental stage would be the automatic activation of a video tape system as the fish pass the camera. It would turn itself off when the fish passed out of viewing range. The feasibility of such a system has been demonstrated in the laboratory, but a practical field application remains to be worked out. Video tape counting could cut the personnel requirements by more than half.

The televised fish counting at Red Bluff has been so successful that similar TV installations are being considered at several locations on the Columbia and Willamette Rivers.

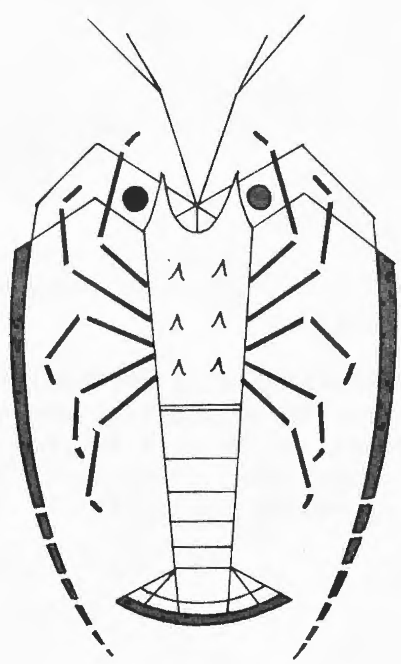
Prior to fish counting by closed circuit television at Red Bluff, fish counters entered one of the small, cold underground counting rooms by climbing down an open hatchway 20 feet to the concrete floor. A 3-foot by 5-foot observation window gave them a view of the 1 1/2-foot-wide channel the fish use to bypass the dam.

Feature attraction on these television screens is the upstream migration of the parade of important commercial and sport fish whose sole interest is reproduction. The viewer's job is to record their passage through the dam.

Between July 1, 1967, and January 1968, 104,000 fish were counted, including 56,000 king salmon, 14,500 steelhead, 1,200 rainbow, 129 shad, 600 squawfish, 4,000 suckers, and 1,000 lampreys. Other fish counted included 15,800 grilse or downstream migrants of various species, 10,000 rough fish and one striped bass.

The fish facilities were designed and built by the Bureau of Reclamation, using criteria developed by the Bureau of Sport Fisheries and Wildlife, and the Bureau of Commercial Fisheries, and the California Department of Fish and Game.

From <u>Reclamation Era</u>, August 1968.



EDWARD PETERSON, Assistant Curator, National Fisheries Center and Aquarium, and in charge of the National Aquarium transferred as of December 1 to manage the Lamar, Pennsylvania, developmental hatchery of the Bureau of Sport Fisheries and Wildlife.

CRAIG PHILLIPS, Assistant Curator, NFCA, has assumed the direction of the National Aquarium.

LOUIS GARIBALDI, formerly with Steinhart Aquarium, San Francisco, is now Curator of Fishes at the new American Broadcasting Company's Marine World at Redwood City, south of San Francisco on the Bay.

NFC&A - Washington, D.C.

Plans and specifications will be complete in January 1969 and invitations to bid on construction of the project are scheduled to go out 30 days later. Construction should start in June 1969, with completion two years later and opening to the public in the spring of 1972.

1969 MODEL OF THE THORNBACK RAY MAKES SHOWROOM DEBUT AT THE CLEVELAND AQUARIUM

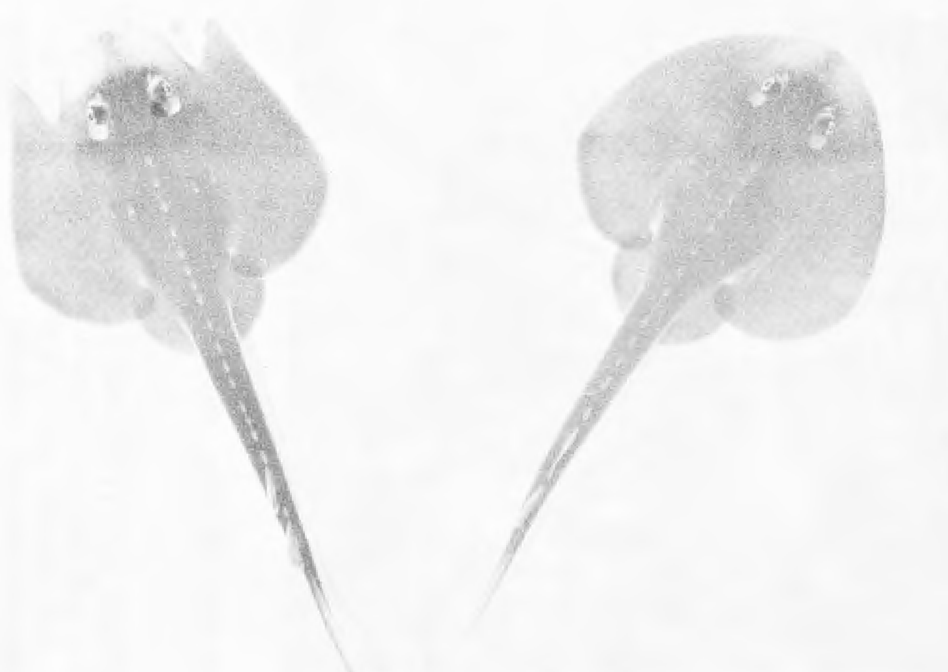
Gerrit Klay

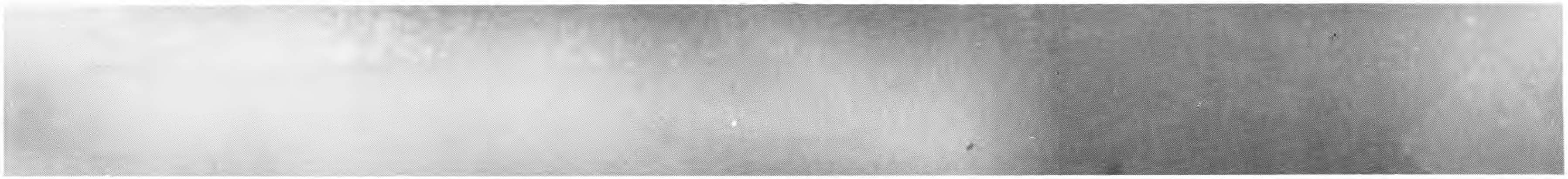
Not to be outdone by manufacturers introducing the new models earlier this year, The Cleveland Aquarium put a 1969 model Thornback Ray *(Platyrhinaides triserriata)* on exhibit September 30th--the very same day it rolled off the assemby line.

The photograph on the left shows the revolutionary design of the new front-end treatment in contrast to the former line. (An interesting mutation.)

Other models of the new production were discarded (to Case-Western Reserve University) due to bent rear drive shafts.

We can imagine no functional advantage to this drastic modification, but it may well become the most popular design in the coming year.

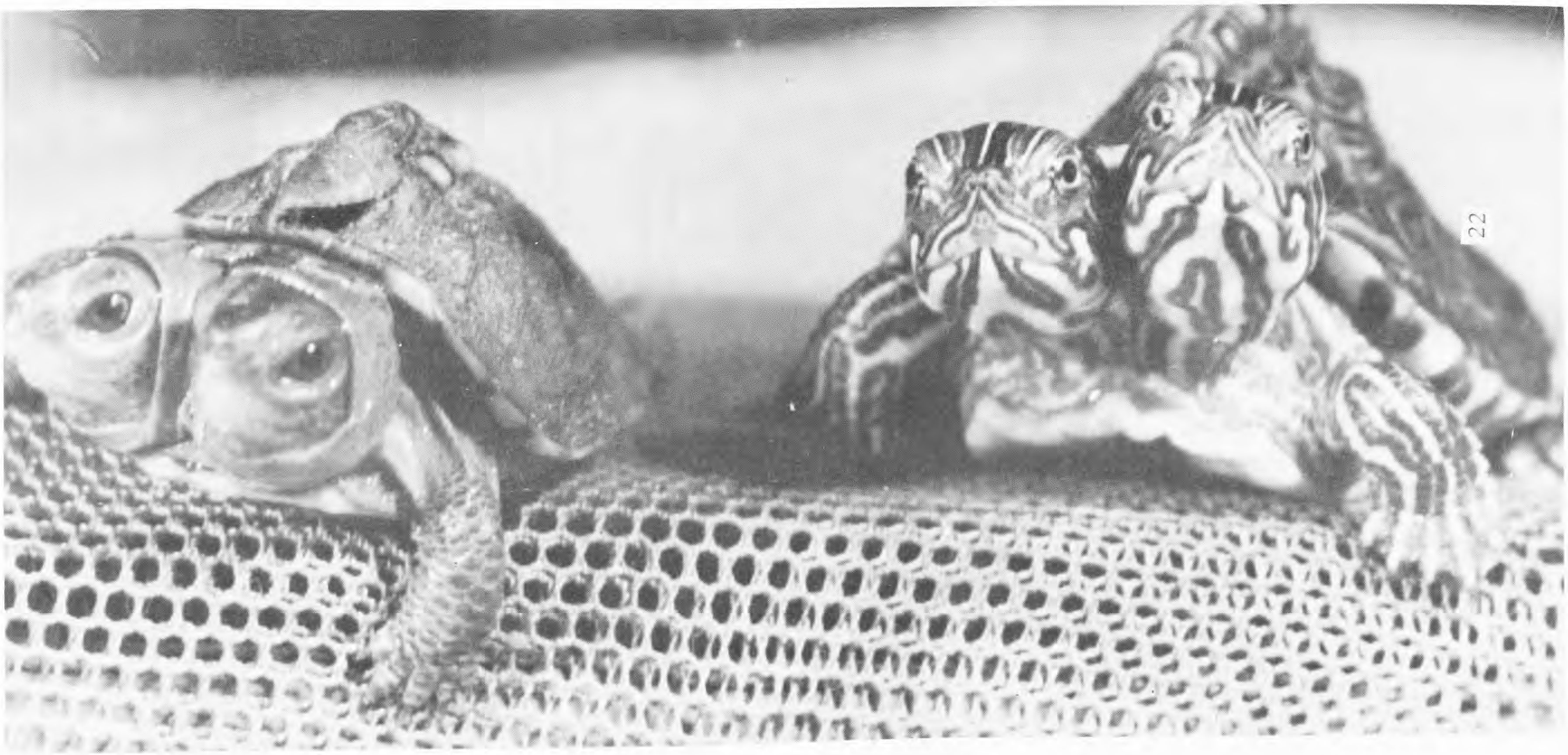




DOUBLE DOUBLE-HEADER

This undated photograph from old files of the National Aquarium is the only picture we have seen of two double-headed turtles (in this case, of different species). Such freaks are actually examples of incomplete twinning within the same egg. They rarely survive for long, as growth is seldom in a perfectly symmetrical fashion and warping of the shell and underlying structures soon interfere with normal growth.

The species, left to right, are the eastern box turtle (*Terrapene carolina*) and the red-eared turtle (*Pseudemys scripta*).



OUTBREAK OF CRYPTOCARYONIASIS IN MARINE AQUARIA[1]
AT SCRIPPS INSTITUTION OF OCEANOGRAPHY

Donald W. Wilkie and Hillel Gordin
Scripps Institution of Oceanography
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ABSTRACT

A histophagic ciliate, *Cryptocaryon irritans* Brown 1951, has been encountered in epozootic proportions in marine aquaria at Scripps Institution of Oceanography. The disease was controlled although not eliminated by copper sulphate treatments. A formalin-copper sulphate shock treatment was development which did eliminate the disease from host fishes. The etiology of the disease is described and experience with other treatments is discussed.

The organism was found in one instance in a local population of tide pool fishes.

INTRODUCTION

In the summer of 1966, there was a severe mortality of marine fishes in both the public and experimental aquaria at the Scripps Institution of Oceanography. A large histophagic ciliate protozoan was identified as the causal agent. This organism, *Cryptocaryon irritans* Brown, was first observed by Sikama (1938) in aquarium fishes from China. He recognized that it was similar to *Ichthyophthirius multifiliis* Fouquet, and later called it *I. marinus* (Sikama, 1961). Brown (1951) in the meantime found the parasite in imported fishes at the aquarium of the Zoological Society of London and described it as a new genus and species. She subsequently reported on its life history (1963). Nigrelli and Ruggieri (1966) encountered the organism in the New York Aquarium, and feel it may be widespread in marine aquaria throughout North America.

The life cycle of *Cryptocaryon* is relatively simple. The parasitic (feeding) stage, the trophont (Fig. 1), ranges in size from 48 to 450 μ along the major axis, lives

[1]Articles of this length are a bit too much for D&C, but we felt its content to be of value to aquarists.

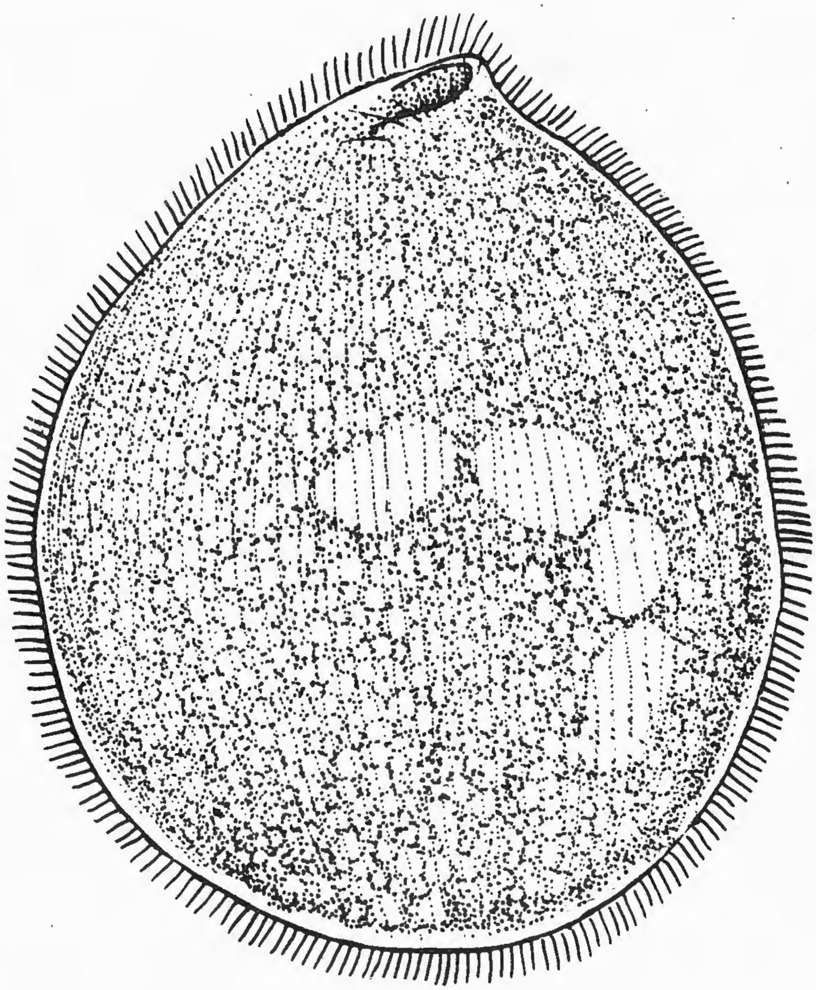

Figure 1 About 8 x 1100.

primarily in and under the epithelial tissues of the skin, gills, eye, buccal cavity and overlying mucous of fishes, where it usually produces opaque white blisters (papules). When these burst the trophonts drop to the bottom where they encyst (tomont stage). Within the cyst, the tomont multiplies and ultimately produces several thousand free swimming tomites (similar to the trophont, but smaller, non-feeding, and with longer cilia) which invade new hosts.

METHODS

For purposes of identification, we took skin smears and gill sections from both infected and non-infected fish, prepared wet, fast-green-stained, and silver-impregnated mounts, and examined them by means of bright field and phase microscopy.

The effectiveness of ozone and copper sulphate solution in preventing infection of fish from encysted *Cryptocaryon* and the influence of temperature on infection were examined (Table 1). In each trial, 10 juvenile opaleye, *Girella nigricans*, were kept in a 15-gallon aquarium containing sand taken from a diseased tank. In the ozone trial, ozone was supplied at a rate of 8 mg/hr by means of a Sander Type II ozonizer. The Cu level in the copper trial was maintained at 0.15 ppm as Cu. Both these experiments and the untreated control were maintained at 19.4 ($\pm$0.2) °C. Two other untreated aquaria were maintained at 14 ($\pm$ 0.2) °C, respectively. All trials were run simultaneously for a period of 22 days.

Copper analyses were made with a Taylor Water Analyzer (1302) and copper slide (130 N). It was necessary to substitute ammonium citrate buffer for the ammonia solution provided by Taylor, because the latter was not suitable in seawater. While analysis is not as accurate as that described by Dempster (1955), it is much easier to perform and is adequate for aquarium purposes. Ten analyses can be done in less than 30 minutes.

A number of other treatments were investigated including: Baslow solution (Nigrelli, 1966), chlorine dioxide, formalin, nitrofurazone, methylene blue, penicillin, quinine, hydrochloride, and Trichofuron in the normally prescribed therapeutic doses.

Following these, a formalin-copper sulphate shock treatment was tested on several species of heavily infected fishes, primarily scorpaenids and serranids. These fishes were first placed for 30 minutes in a bath of 0.4 ml concentrated formalin per litre of aquarium water before copper sulphate solution was added to a concentration of 2.0 ppm as Cu. The seawater supply was then turned on at a rate which reduced the Cu level to 0.4 ppm over a period of two hours with concommitant dilution of the formalin. At this stage, the flushing rate was decreased by a factor of approximately four and flushing continued until the aquarium was free of copper and formalin.

Smears taken from newly collected fishes found in tidepools along the La Jolla shore and from fishes caught in Mission Bay were examined for *Cryptocaryon* during the summers of 1966 and 1967.

OBSERVATION AND RESULTS

The diagnostic cytological characteristics including general morphology, size, kinetosomes, buccal cavity structure and the 4-lobed meganucleus were identical to those described by Sikama (1938), Brown (1951) and Nigrelli and Ruggieri (1966). The lobed meganucleus was occasionally observable in wet mounts as well as in stained preparations.

Cryptocaryon was first known to be present at Scripps when it attained epizootic proportions in August of 1966 and the majority of aquarium fishes were afflicted. Aquarium water temperatures were above 20°C and had been since early July. If left untreated even normally hardy species such as garibaldi, *Hypsypops rubicunda,* and opaleye died within a few days after white papules were visible macroscopically. For example, six seemingly healthy garibaldi living in 23°C water, stopped eating, developed frosty corneas along with respiratory distress within 3 days, and 3 days later were dead. In most species of fish, paling of the skin became noticeable after the loss of appetite, and prior to the clouding of the corneas. Within 2 to 3 days after paling, pinhead-sized white papules developed over most of the body and fins. After the first few days of infection, sub-surface hemorrhaging usually became increasingly apparent, particularly in the fins. Respiration rates increased steadily during the last few days of the disease until death occurred. An additional symptom in yellowfin croakers, was the copious sloughing of integumental mucous in stringy masses.

Fish attacked by the disease included both tropical and temperate species. The garibaldi was highly susceptible to the disease, apparently more so than any other species kept in the aquarium. No *Cryptocaryon* were found in smears from elasmobranchs or the gobiid *Lythrypnus*, and only an occasional one was found on muraenids, bothids, and pleuroncetids. A number of species did not exhibit macroscopic symptoms of the disease.

The cold seawater tank (mean temperature 15°C) which contained primarily scorpaenids did not become infected, nor has there been an outbreak of *Cryptocaryon* in any of the untreated tanks during winter (temperature $<$15°C). Throughout this period, however, the tropical tanks (20° to 26°C) have had to be treated regularly in order to control infection.

TREATMENT

In 1966, as soon as a protozoan was implicated in the disease, all tanks suspected of being infected were treated with copper sulphate solution, in a manner similar to that described by Dempster (1955), except that the ratio of citric acid and copper sulphate was increased from 1:100 to 1:5. Treatments were daily in most aquaria throughout the summer and fall of 1966 and 1967 and have been sustained almost continuously since 1966 in the tropical tanks. Since the seawater system was open and chemical metering devices were not available, constant Cu levels could not be maintained. Twice a day the level was brought to 0.3 to 0.4 ppm as Cu. During the interim additional copper sulphate solution was supplied by means of drip bottles to partially compensate for dilution. By this method the copper levels seldom dropped to lower than 0.15 ppm as Cu during the course of treatment.

Fishes treated with copper sulphate solution at 0.1 to 0.4 ppm Cu level were usually cured if treated during, or prior to, the early white-spot stage of the infection. Those that had reached more advanced stages almost invariably died. The disease had a tendency to reappear after termination of the treatment, particularly in warmer water aquaria. Furthermore, this treatment had no noticeable effect upon the trophont stage of *Cryptocaryon*. Smears from infected fishes treated at 0.4 ppm Cu level for 24 hours still contained an abundance of active trophonts.

In the experiment with encysted *Cryptocaryon*, no infection occurred during a period of 21 days in the aquaria containing ozone and copper sulphate or in the untreated 14°C tank. Infection occurred in the untreated 23°C tank after 7 days and after 14 days in the 19.4°C untreated tank.

The Baslow treatment was effective only in relation to the copper level it produced and maintained, and appeared no more effective than the copper treatment alone. It had no observable effect on attached trophonts.

The only treatment found to be more effective than the standard copper sulphate treatment was the formalin-copper sulphate shock treatment. Fishes at the white-spot stage, treated in this manner, contained no visible *Cryptocaryon* in smears taken during the next 24 hours.

FIELD STUDIES

Since the summer of 1966, over 1000 newly collected fishes from the La Jolla and Mission Bay areas have been examined. One mildly infected opaleye was found in a lot of 100 fishes of 3 species taken in tide-pools 300 m north of Scripps pier.

Some *Cryptocaryon* also were found on an opaleye from a home aquarium equipped with all new materials and stocked with fish from tide-pools 3 miles south of Scripps. Similar experiences have been reported by persons setting up aquaria at Scripps, but in these instances there was a possibility that the disease was introduced with the materials or seawater, and was not originally on the fish.

DISCUSSION

The source of the *Cryptocaryon* infection at Scripps is not known. If as Sikama (1961) postulates the disease is world-wide in distribution, then it could have entered the aquarium from the local waters through the seawater supply. However, he reports the disease only from the water adjacent to Japan, and there is no previous record of its occurrence in eastern Pacific waters. The 1966 outbreak appears to be the first at Scripps according to the aquarium records and the observations of Carr Tuthill (aquarium curator, Scripps, personal communication) over the past 15 years. This suggests the previous absence of the organism in local waters.

Nigrelli and Ruggieri, on the other hand, believe this parasite has become established in North America aquaria through marine fishes imported from Hawaii and the Indo-Pacific. It could have arrived at Scripps in this manner and subsequently could have been introduced to the local waters from the aquarium effluent. This also could have happened at Sea World were the disease has been present (David Powell, curator, Sea World, San Diego, personal communication).

The pattern of susceptibility in western Pacific fish families observed by Sikama (1938) is similar to that at Scripps. It appears that elasmobranchs in general are little affected by *Cryptocaryon*. The resistant teleosts seem primarily to be those that live in contact with the substrate, and it may be the mechanisms which protect them from abrasion injuries (such things as small or no scales, abundant mucous, etc.) provide a resistance to *Cryptocaryon*.

The standard copper sulphate treatment is effective inasmuch as the fish recover if treated early enough. Since the effectiveness of copper solutions on protozoans appears to be limited primarily to its lethal action on the free-swimming stages, a common aquarium practice is to maintain low levels of copper ion as a preventative measure. This is undesirable since it is believed that copper is a cumulative toxin and should not be used over long periods. Further, it is highly toxic to invertebrates, so they cannot be displayed in the same tank with treated fish.

The only treatment which we found effective against attached trophonts was the formalin-copper sulphate shock treatment. However, the initial Cu level is much above that considered safe by aquarists. While we have experienced no mortality with this treatment, it has been used only with a few species of fish which we consider hardy, principally scorpaenids and serranids. This treatment, therefore, should be used with caution.

The tests of the majority of treatments were only cursory and based on dosage levels recommended by van Duijn (1967) for freshwater fishes. It may be that some of these treatments might be of value at higher dosages or if administered in a different manner. Ray Benoit (Triton Aquatics, Inc., Levittown, Pa., personal communication) reports that ozone is effective if the temperature is raised above 30°C. This has limited usefulness since such a temperature would be lethal to many of the species in our tanks.

SUMMARY

Cryptocaryon irritans was identified as the causal organism in a severe disease outbreak in marine fishes maintained at the Scripps Institution of Oceanography in 1966.

The outbreak occurred during a period of increased water temperature. It did not affect fish kept in cold seawater ($T < 15°C$).

Cryptocaryon was found on a newly caught local fish and on fish from an aquarium in which there was only a slight possibility of the organism being present prior to the introduction of local fish. This is the first known record of the organism in eastern Pacific waters. However, the occurrence in local waters could have resulted from aquarium effluent.

Low levels of copper sulphate solution 0.1 to 0.4 ppm as Cu were effective in preventing infection, but had little effect on the attached parasitic stage.

A formalin-copper sulphate shock treatment was effective against the parasitic stage and had no lethal effect on the host fish.

ACKNOWLEDGEMENTS

To all those who helped with treatments, observations, and collections we offer sincere gratitude; particularly Alex Beamer, Chuck Farwell, Kathy Hartwell, Monte Kirven, Bill Mautz, Dan Popper, Pat Smith, Bob Snodgrass, and Carr Tuthill. Ray Benoit of Triton Aquatics, Inc., kindly supplied the ozonizer.

Special thanks are owed to William Newman and Richard Rosenblatt who read the manuscript and offered a number of helpful suggestions.

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TABLE 1

The effect of temperature, copper sulphate and ozone on encysted *Cryptocaryon irritans* infecting opaleye *Girella nigricans*.

Days exposed	Treatment				
	Ozone 19.4°C	Cu++ 0.15 ppm 19.4°C	Ambient 19.4°C	Warm 23°C	Cold 14°C
1	A	A	A	A	A
7	A	A	A	P	A
15	A	A	P	P	A
21	A	A	P	P	A

A=Absent P=Present

Ed. Note: Those interested in learning of the species found to be susceptible to *Cryptocaryon irritans* during the period 1966-1967 should correspond with the authors.

ABSTRACTS of papers presented by Donald W. Wilkie, Scripps Institution of Oceanography, La Jolla, California, at the Aquarium Symposium ASIH annual meeting - Ann Arbor, Michigan, June 1968

(Received too late for D&C of Sept. 1968)

EDUCATIONAL PROGRAM AND POLICIES AT THE T. WAYLAND VAUGHAN AQUARIUM-MUSEUM

We have found that most teachers do not prepare properly for field trips. To help overcome this situation and to ensure that visiting groups have an optimal opportunity to learn from their study trips to the Aquarium-Museum, a three-part education program has been developed for visiting school groups.

The program consists of prepared previsit and postvisit lessons to be given by the teacher in the classroom; an introductory talk given at the aquarium by a trained volunteer docent, followed by a self-guided tour using guide sheets. The lesson material is keyed to seven different levels from kindergarten through junior college. During the 1967-1968 school year over 30,000 students participated in the program. The prepared material was used by virtually all groups.

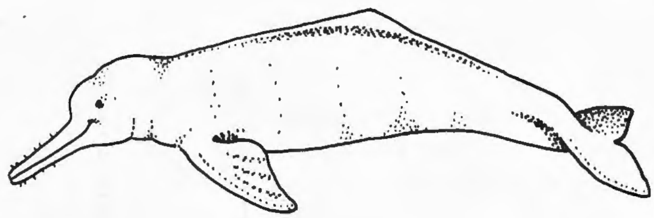
EFFECT OF COPPER SULPHATE ON THE CALIFORNIA SPINY LOBSTER

Copper as Cu^{++} has been used by many aquarists to control protozoan disease of marine fishes. The dosages used, have generally been considered highly toxic to invertebrates. In the Scripps Aquarium, however, lobsters, *Panulirus interruptus*, have been left in tanks during treatment of fishes over a period of one year at average dosages of 0.15 ppm as Cu^{++} with no significant increase in mortality. Similarly, a tropical hermit crab (*Paqurus* sp.) has been found to survive at Cu^{++} levels up to 0.3 ppm for greater than seven months.

NOTES ON THE GROWTH OF A FRESH-WATER DOLPHIN *(Inia geoffrensis)*

Donald Zumwalt
Curator

John G. Shedd Aquarium



Pink fresh-water dolphin, or Boutu *(Inia geoffrensis)*

This strange and primitive cetacean belongs to the family Platanistidae or river dolphins, of which there are four kinds living in widely separated parts of the world. The eyes are small; the long snout is covered with sparse hairs with which the animal is believed to locate its food in muddy water. The young are nearly black, while the adults (6–7 feet) are pink in color. Recently, several of these remarkable creatures have been obtained from the upper Amazon by aquariums in the United States.

The number of fresh-water dolphins being held in captivity has rapidly increased in the last 10 or 12 years, with no end in sight. Information regarding feeding habits and the growth rates for these animals in captivity are lacking and will be needed in the future as more animals are exhibited.

Chico, our fresh-water Dolphin has been a popular exhibit animal since its acquisition on the 5th of December, 1965. From his arrival at the Aquarium to the present time, a record of his food intake and resulting growth has been kept. This record should be of interest to those presently exhibiting these animals and to those contemplating it in the future.

Many species of fish have been fed and accepted by Chico. Some fish are preferred to others and often size and preparation will have a great bearing on the preference by Chico.

Vitamins, minerals, and supplements are given (usually at the direction of our consulting veterinarian) by inserting a gelatin capsule into the body cavity of the fish being fed.

Chico was first weighed on January 7, 1966. He weighed 80 pounds. His resulting growth for the next three years, in weight and length can be seen in figure I.

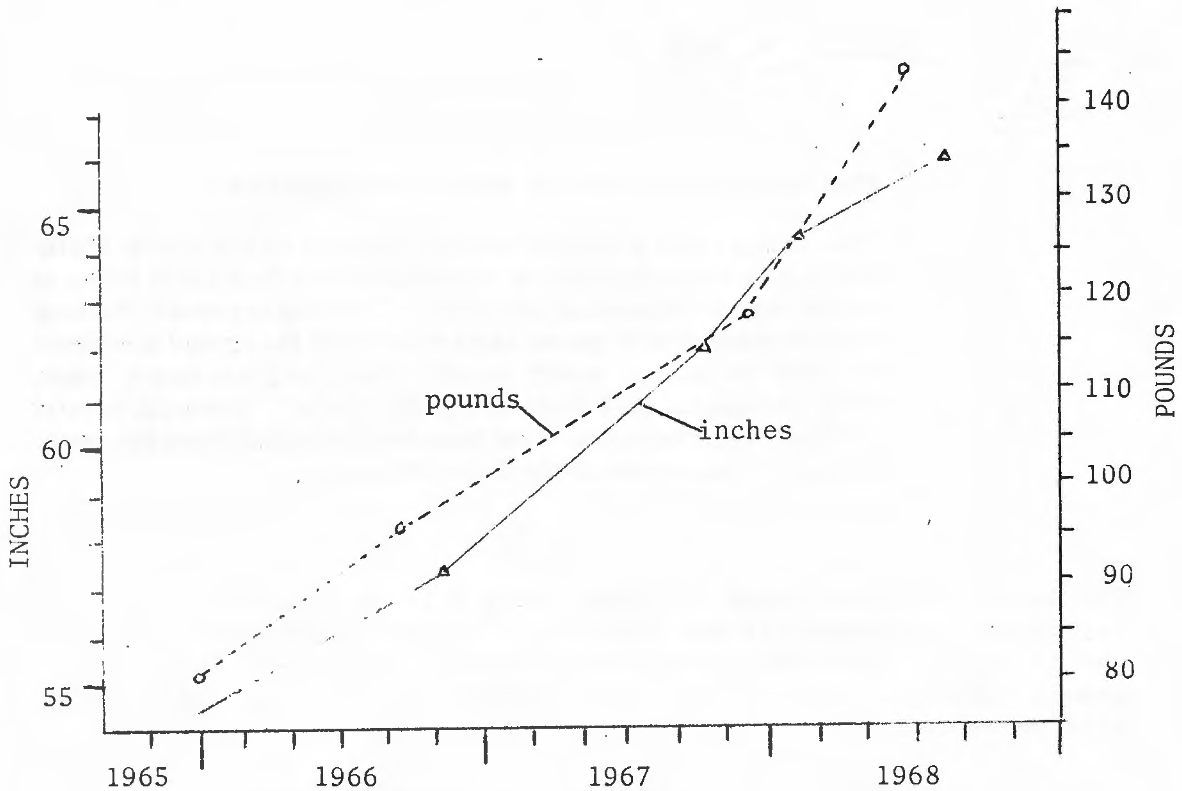


Fig. I -- Chico's growth in pounds and inches (from tip of upper jaw to deepest part of notch between flukes).

Table I shows the yearly feeding record for 1966, 1967, and 1968. These three yearly periods show the total number of days per month fed, the average poundage fed on these days, the total pounds of food fed per month, and the type of fish fed for that particular month.

Lake herring *(Leucheoththys sp.)* and sea herring *(Clupea harengus)* have been fed over 57% of the time, yellow perch *(Perca flavescens)* and Atlantic mackerel *(Scomber scombrus)* comprising 36%, and 7% of the time for other fish.

A determined effort to increase Chico's food intake, starting in February, 1968 resulted in a definite weight gain. By the following August he had gained 24 pounds, had become lethargic, and physically was actually "Rolly Polly." At this time his food intake was reduced to around three pounds.

During the thirty-four-month period, Chico's average daily intake was 3.27 pounds. His total consumption of food for this period was 3238.2 pounds.

This data should furnish a background of information for not only growth, but to determine the actual cost of feeding an animal for a specific length of time.

It should be mentioned that Chico is not subjected to any physical demands (training or show routines), is healthy, and kept under controlled temperature and water conditions. A deviation from these conditions may increase or decrease food intake and in turn growth.

TABLE I

	1966				1967				1968			
	No. days fed	Pounds Per day	Pounds Month total	Food (1)	No. days fed	Pounds Per day	Pounds Month total	Food	No. days fed	Pounds Per day	Pounds Month total	Food
Jan.	19	2.7	52.0	s,c,bf	30	2.4	71.6	m	30	3.7	112.0	h
Feb.	26	3.1	80.6	s,p,m,sar,w, but,br,h	24	2.3	55.0	m,h	26	3.6	93.4	h
Mar.	31	3.4	105.2	p,c,wf,w,m	30	2.9	86.3	h,c	31	3.9	120.5	h
Apr.	28	2.3	63.4	p,m	30	3.5	104.9	h	26	4.6	119.0	h
May	30	2.4	72.8	m,p	30	3.1	91.7	h	31	5.4	168.0	h
June	29	2.2	62.6	c,m,p	30	3.1	91.7	h,m	26	6.2	160.0	h,m,p
July	30	2.2	67.4	m,p	31	3.4	106.8	h	25	5.9	148.0	m,p,h
Aug.	30	2.9	85.6	m,p	31	3.4	104.6	h	30	3.5	105.0	h
Sept.	29	3.0	88.0	m,p	29	3.4	99.4	h	30	3.0	90.0	h
Oct.	31	2.4	73.4	m,p	31	3.7	115.7	h	31	3.0	93.0	h
Nov.	30	2.1	62.6	m,p	30	3.5	106.0	h To Date	286	4.2	1208.9	
Dec.	31	2.3	71.2	m,p	31	3.6	110.8	h				
Yearly	344	2.6	884.8	Yearly	357	3.2	1144.5					

(1) s=smelt, c=carp, bf=blue fin, p=perch, m=mackerel, sar=sardines, w=walleye, but=butterfish, br=blue runner h=herring, wf=white fish

MISCELLANY

(Taken from Bill Braker's report to the AAZPA)

The Arizona-Sonora Desert Museum is in the process of rejuvenating its fish room. Steel tanks are being replaced with fiberglas, with artificial rock backgrounds. When completed there will be approximately 25 freshwater species on display in addition to a number of marine specimens from the Gulf of California.

Forth Worth has renovated its 2,000-gallon exhibit tank, dividing it into three sections with glass partitions. This makes it possible to display predator and prey species apparently swimming together. On May 1, ground was broken for a new wing, which will display harbor seals and sea lions, and also include 28 tanks for coastal fish and invertebrates as well as a hexagonal community tank for native fishes. Cost is estimated at $120,000.00 and was scheduled to be completed in November.

The New York Aquarium lost Lupa, its killer whale, in early September. It has been in the Aquarium since April 1. At 18 feet, she is reported to be the largest animal ever transported by air. As of this date, I do not have any information on the cause of death.

While New York was losing its animal, Marine World at Redwood City reported the still birth of a 62-pound, 52-inch calf. The mother was an 8,000-pound, 21-foot killer whale named Clyde. This was the second still birth at Marine World. The first baby weighed 250 pounds and was seven feet long.

The Aquarium of Niagara Falls is constructing a 2,000-gallon sea lion tank and training facilities, in addition to adding D. E. filtration to their 10,000-gallon *Inia* tank.

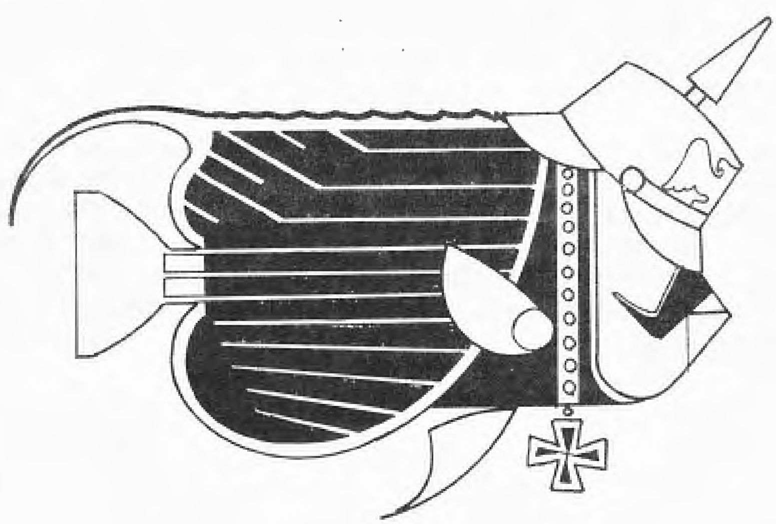
The Miami Seaquarium has been busy with various improvements of the physical plant, principally improvement of the water supply and filtration. This institution has also added *Orcinus* to its collection, as well as another white porpoise *(Tursiops truncatus)*, which was captured August 11, in South Carolina waters. It was found in the same general area as "Carolina Snowball," which was captured in 1962.

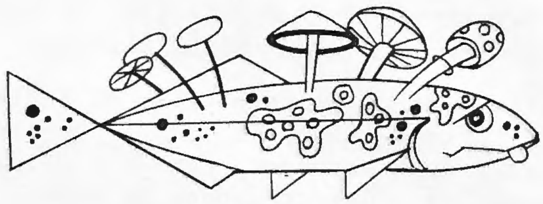
Meanwhile, back at the killer whale ranch, Vancouver Aquarium has opened a special facility at Pender Harbor, B.C., to display killers in a natural environment. Several of these animals are on exhibit in pens along the shore. The pod originally consisted of three animals named in the Chinook jargon--Hyak, Natsidalia and Skookum-Cecil. However, on August 26, Skookum-Cecil sought the wide open sea and gave his keepers the slip through openings in the enclosure. Although the staff was sad to have lost such a magnificient beast (21 feet, 10,000 pounds), this has decreased the food consumption by 250 pounds of herring a day.

Not content with killers, Vancouver launched an expedition to Baffin Island in August to study the feasibility of capturing narwhals. Although none was taken, it is now felt that enough is known of their habits to carry out a successful collecting trip in August 1969.

Editor's Note: Bill Braker sent out 30 questionnaires to aquariums throughout the country and received only nine replies.

Just how do you get presumably interested aquariums and individuals to contribute--not money, just news.





SOME PARASITIC FUNGI AFFECTING AQUARIUM FISH

Edward J. Peterson
Assistant Curator
National Fisheries Center and Aquarium

(Ed.: This article, one of a series prepared by Mr. Peterson for a Washington aquarium society, is included in D&C for the less experienced aquarists -- and possibly the professionals -- on our mailing list.)

Fish "hobbyists" tend to use the term "fungus" to describe numerous afflictions encountered in their fish. The term has been badgered and misused for so long that it seems necessary to redefine fungi before continuing this article.

According to Hoffman (1967), "Fungi are plantlike structures lacking chlorophyll; the assimilative phase consists of a true plasmodium or mycelium, or rarely of separate uninuclear independent cells not amoeboid and at no time uniting as a plasmodium-like structure."

There are two classes of fungi which commonly affect fish. These are Class Plycomycetes containing the genus Saprolegnia and related genera and Class Fungi Imperfecti containing the genus Ichthyophonus.

"Saprolegnia, the most ubiquitous genus of aquatic fungus, commonly attacks fish. It must, however, always be regarded as a secondary parasite which establishes itself in a defect caused by another agent, either an injury or a primary parasite," (Reichenback, Klinke and Elkan 1965). This is the common fungus most aquarists encounter. It is easily recongized by the white cottony form which is familiar to virtually all who observe or maintain fish. The most important point to remember regarding Saprolegnia: It is generally a secondary infection, consequently one must eliminate the primary causative agent before the fungus can be cured.

Saprolegnia grows on various kinds of submerged decomposing organic matter. The reproductive asexual spores are present almost everywhere in natural waters. The very best method of combating this fungus is through sanitation and tender care. Any surplus food, mulm or dead fish in the tanks can act as a reservoir of infection, becoming covered with a luxuriant growth of the white cottony moldlike mass. This growth results in formation of multitudes of zoospores. These reproductive products, free in the water, are capable of entering the slightest wound in a fish, starting from a focus, and spreading over the skin of the fish.

The following are some standard forms of chemotherapy which have been employed by various fish culturists.

Copper Sulphate: 1:2000 solution dip for one minute (Davis 1961). (6 oz. of 1:100 of stock solution per gallon.)

3% Salt (NaCl): Dip until fish show signs of distress (Davis 1961). (4 grams NaCl per gallon.)

Malachite Green (zinc free): 1:15000 solution dip for 10-30 seconds (Davis 1961). (1:2/3 oz. of 1:100 of stock solution per gallon.)

Potassium Permanganate: 1:100,000 bath for 90 minutes (Reichenback, Klinke and Elkan 1965). (1 oz. of 1:100 of stock solution per 8 gallons.)

Prepare the treatments from the following instructions:

For a 1% or 1:100 stock solution:

38 grams per gallon

1.3 ounces per gallon

*10 grams per 1000 ml (1 liter)

38 ml per gallon

*10 ml per 1000 ml

*(Note - 3785 cc or ml equal 1 gallon)

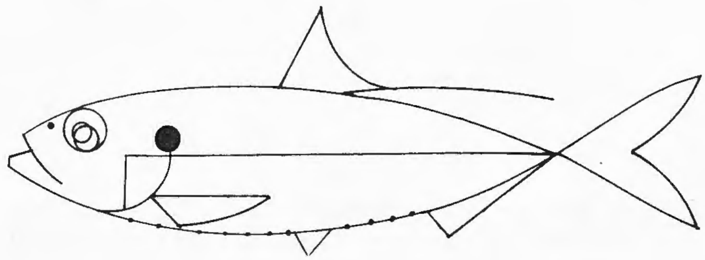
Caution: Measure your quantities accurately and do not exceed the recommended dosage. (Twice as much is not twice as good -- but it may eliminate your problem and your fish. Ed.)

Bibliography

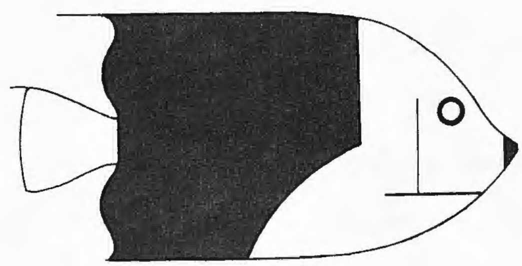
Davis, H.S. Culture and Diseases of Game Fishes, University of California Press, Berkeley and Los Angeles, 1961.

Hoffman, Glen L. Parasites of North American Freshwater Fishes, University of California Press, Berkeley and Los Angeles, 1967.

Reichenback, Klinke and Elkan, The Principal Diseases of Lower Vertebrates, Academic Press, London and New York, 1965.



WERNER SCHRODER, Director, Berlin Aquarium, was in Madagascar last October and November. He collected some uncommon catfishes and Mormyrids in Tanzania and also has some freshwater rays from the Rio Negro. We thought surely he'd bring back alive a coelacanth!



We know it's often hard to tell the boys from the girls --- but in the animal world??

<u>This</u> turned out to be <u>this</u>:

Moby Doll	Moby Dick
Eugenie	Eugene
Clyde	Bonnie