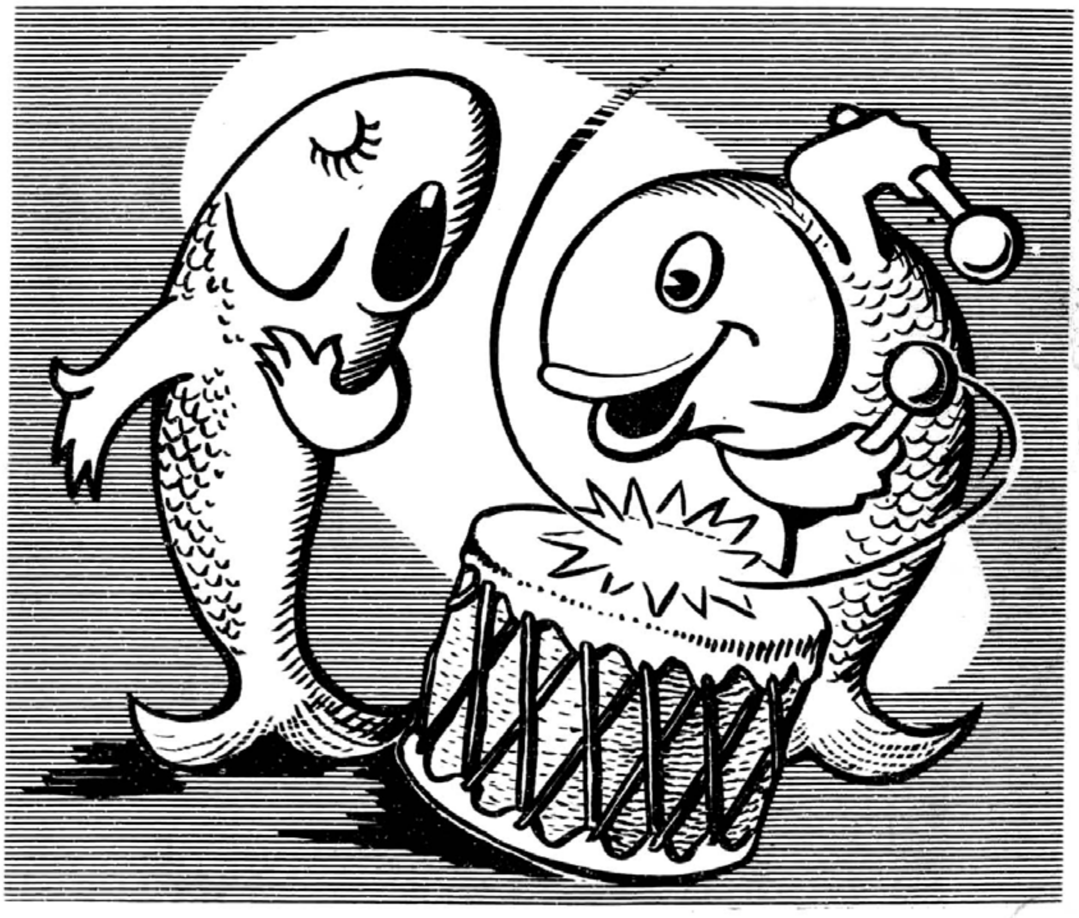
The DRUM and CROAKER

A Highly Irregular Journal for the Public Aquarist



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Aquarium Symposium

American Society of Ichthyologists and Herpetologists

Meetings

June 19 - 25, 1966

- Miami, Florida

* * *

Aquarium Symposium June 19 and 20

at

Seaquarium

Mr. Burton Clark has extended an invitation to all aquarists to attend and visit. Seaquarium's boat will also make several short trips for collecting.

All reports of pending meeting indicate a great success - All papers will be taped in advance - Those you desire will be available for a nominal charge - This will leave entire week open for . . . .

ANTHIUM DIOXIDE - A REVELATION

Warren Zeiller, Curator of Fishes, Miami Seaquarium

Twenty years have passed since the Gelfand Patent proved the value of the combination of copper sulfate and citric acid as an algaecide and fungicide. Through seventeen years of patent duration aquarists waited hungrily for its expiration so they too might reap the rewards of its benefits. Now, only a year or two after the long wait ended, a new development may change the entire picture.

A revolutionary water additive soon will be available under the trade name Krystal Klear. This liquid chemical compound is an Anthium Dioxide complex, the basis of which is chlorine. Startling? Indeed! Chlorine in its many forms is fine in swimming pools and drinking water, but always has proved a deadly addition for all but mammalia in aquatic environments. The new product, fine also in swimming pools, etc., is, under controls no more difficult to maintain than those for copper compounds, harmless and even beneficial to aquatic vertebrata. Unfortunately, like copper compounds, it is not tolerated by most invertebrates.

Experiments with Anthium Dioxide have proved the following:

I. <u>Control of Algae, Bacteria and Fungi in Water Containing Aquatic Mammalia</u>.
The chemical was pumped directly into the water supply line of a 160,000 - gallon semi-closed system pool (approximately 10% daily water make-up) containing one and sometimes two or three bottlenosed dolphin (<u>T</u>. <u>truncatus</u>). Salt water for the system is filtered by three drum-type sand-gravel pressure filters. Within one week the water was quite colorless and crystal clear! The mount of residual chlorine in the system was tested with an inexpensive standard swimming pool test kit using orthotolodine (O.T.O.) as the reagent. Fishes have been found to tolerate 0.5 ppm residual chlorine for indefinite periods of time. This amount was set as the maximum for the porpoises as well, and probably allowed a high margin of safety. Readings during the test period varied from 0.3 ppm to 0.5 ppm and were maintained by daily additions of the chemical. The mount to be added will vary directly with the contamination in a System. As microorganisms are reduced, the chlorine residual will increase and the feed rate must be reduced to maintain the proper residual.

In addition to extreme water clarity, the divers who vacuum and scrub algae from the inside of the pool stated that the algae, though still present, took less effort to remove than when copper sulfate was used as an algaecide. Bacteria counts were taken during the test period and were compared with those taken during the same time the previous year. The counts proved to be little more than half of what they had been. This provides a healthier environment for the porpoises and leaves enough bacteria to maintain efficient biological filtration. In all, this experiment was a total success, and I foresee no reason why the product will not perform as well in pools containing sea lions, seals, and the like.

II. <u>To Maintain a Healthy Environment for Fishes (exclude Invertebrata)</u>. A series of experiments were conducted involving dozens of marine and several fresh-water species. Preliminary tests were run to determine fishes' tolerance, if any, for the product. One ppm of residual chlorine was found to be toxic after one or two weeks immersion. Specimens seemed to lose equilibrium and swim in tight circles until they expired. If caught in time and placed in untreated water they survived. Finally, 0.5 ppm residual chlorine was found to be the point at which vertebrate species can live indefinitely and at which the strength of the chemical is adequate to perform its functions. At 0.5 ppm fishes can be introduced safely into or removed from the water with no ill effects.

All tests were conducted in 15 to 50 gallon aquaria, during which several interesting points came to light. When specimens were fed, excess portions of food were left intentionally on the bottom. Instead of decomposing in the usual manner, i.e.; turning black and producing foul odors, (hydrogen sulfide), waste portions of fish decomposed into a harmless, finely divided granular white mass, as did waste from the specimens. Even sea anemones, whose death and decomposition often annihilate fish populations, did the same; the demise and decomposition of an anemone or other invertebrate did not result in the usual fish mortalities.

The chlorine product was then tested in six 30 gallon display aquaria containing numerous fine specimens too small or prized to be shown elsewhere. Laboratory tests had shown that the chemical, at the relatively low concentration of 0.5 ppm residual chlorine, was not strong enough to destroy algae already established. Thus, all experiments here were conducted in aquaria which first had been thoroughly cleaned. A rule of thumb regarding the amount of chemical to be added was developed at this point. Two drops per gallon of water worked unfailingly as a safe method of introduction. The final quantity required to maintain the desired level of 0.5 ppm varied according to the number and size of specimens present in the aquarium. Daily testing with the standard OTO swimming pool test kit and further addition of the chemical when needed to reach 0.5 ppm was all that was required to maintain the aquarium. Once the optimum level was reached and held for a few days, daily testing was no longer necessary. Periodic checks and chemical addition when necessary were sufficient.

Normally, the six display aquaria are emptied of their contents and cleaned monthly. This, of course, is subject to many variables with which aquarists are familiar. When treated with Anthium Dioxide, cleaning time was extended to six weeks or more, and even then there was not as much algae and foreign matter present as there had been previously after one month. Specimens retained their vivid natural colors, fed well, and remained fully active. Their whole state of well-being seemed greatly improved, although no other variations in normal care were introduced.

III. <u>As a Quarantine for Sea Horses</u>.

Sea horses from local waters invariably arrive at Seaquarium bearing parasites, referred to as copepods. Those visible to the naked eye always have been removed by hand and the sea horses then placed in their 300 gallon open system aquarium. Shortly thereafter, row upon row of tiny white specks appeared on the aquarium glass -- the eggs of copepods, thriving at the expense of the sea horses.

In testing as many species as possible for tolerance of the chlorine product, sea horses soon entered the picture. After each test, the parasitic copepods were found, not on the sea horses, but dead on the aquarium glass above the water line. Further work proved that sea horses quarantined in a concentration of only 0.2 ppm residual chlorine for forty-eight hours emerged parasite-free and in a state of health they seldom enjoy in their natural habitat. This finding prompted treatment of the entire 300 gallon display, including ten golden-browed jawfish, (O. aurifrons) which were heavily infested at the time. They lived in burrows and shells on the bottom of the sea horse aquarium, and large copepods were plainly visible in alarming numbers on their bodies. In two days at 0.2 ppm the copepods were no longer in evidence. The entire aquarium has been 100% free of these parasites since the quarantine measure has been inaugurated and followed religiously. In addition, the longevity of the sea horses after treatment has increased gratifyingly, to what extent one cannot even guess. The end is truly not yet in sight.

Seaquarium is basically a marine exhibition and the majority of this research was done in salt water. It must be noted that Anthium Dioxide is most efficient in the low pH range of fresh water; therefore it is a boon to all aquarists. Of particular interest is the fact that one fresh-water Belonesox belizanuf gave birth to two large groups of normal, healthy young in an established Krystal Klear environment. A number of these were raised successfully to a length of two inches and then transferred to an open system untreated display aquarium without special precautions or difficulty. Regardless of the kind of water, the treatment is most effective and least expensive in completely closed (100% recirculation) aquaria systems.

I wish to acknowledge the assistance of Mr. Thomas Marooney, Account Executive of Williams Chemical Corporation of Miami, for supplying Seaquarium with the materials for these experiments.

N O T I C E

D & C non-editorship

Mr. Burton Clark and Curator Warren Zeiller

have accepted the non-editorship of D & C.

Manuscripts and other future inquiries should be

mailed to Seaquarium.

OBSERVATIONS ON HYPOCHLORINATION WITH MARINE FISHES

R. A. Martin, Aquatarium, St. Petersburg, Fla.

Among the various chemicals used for combating bacterial productivity in salt water systems containing living animals, chlorine has often been condemned because it is toxic to fishes. Very little information is available on the toxicity of the gas or its related forms. Leibmann (1960) gives a level of 0.05 to 0.40 ppm as the lethal limit for fishes.

HTH, sodium hypochlorite, and other preparations may be obtained in quantity and have proven economical in large scale operations, where large quantities of water must be treated. At the Aquatarium, where a battery of large carbon filters handle the 1,247,000 gallons of salt water in the main tank, sodium hypochlorite has proven economically feasible. Other compounds are lost so fast from the system that the cost of maintaining them becomes prohibitive.

During October and November of last year, we attempted to determine what the reactions of a vast array of marine fishes would be to hypochlorination with sodium hypochlorite. Two epoxy coated plywood tanks (30 gal. - 18"x30"x18" and 200 gal. - 6 ft.x3ft.x2 ½ft.) were outfitted for this purpose. Partitions were provided when fishes needed to be segregated; and rocks and coral were placed so that fishes could obtain cover. Aeration was regulated as to meet the needs of the fishes, and normal chemical conditions were maintained as much as possible: pH, salinity, etc.

A measured quantity of 1 percent Sodium Hypochlorite solution was added to each tank by means of a graduated pipette. The residual chlorine was checked throughout each day, and regulated, if necessary by adding additional hypochlorite. The "orthotolidine - colorimetric" method was employed to check the chlorine level.

Initial tests on fishes were designed to survey the various species available to us at the Aquatarium. Not more than one or two specimens of some 27 species were used, but the healthiest individuals were chosen. Figure 1 indicates the level of residual chlorine during the course of this experiment. An attempt was made to increase the residual in stages, but each time a peak was reached, the level was allowed to drop in a normal manner. There are many defects in the method we have employed, but the indications may be taken for what they are worth.

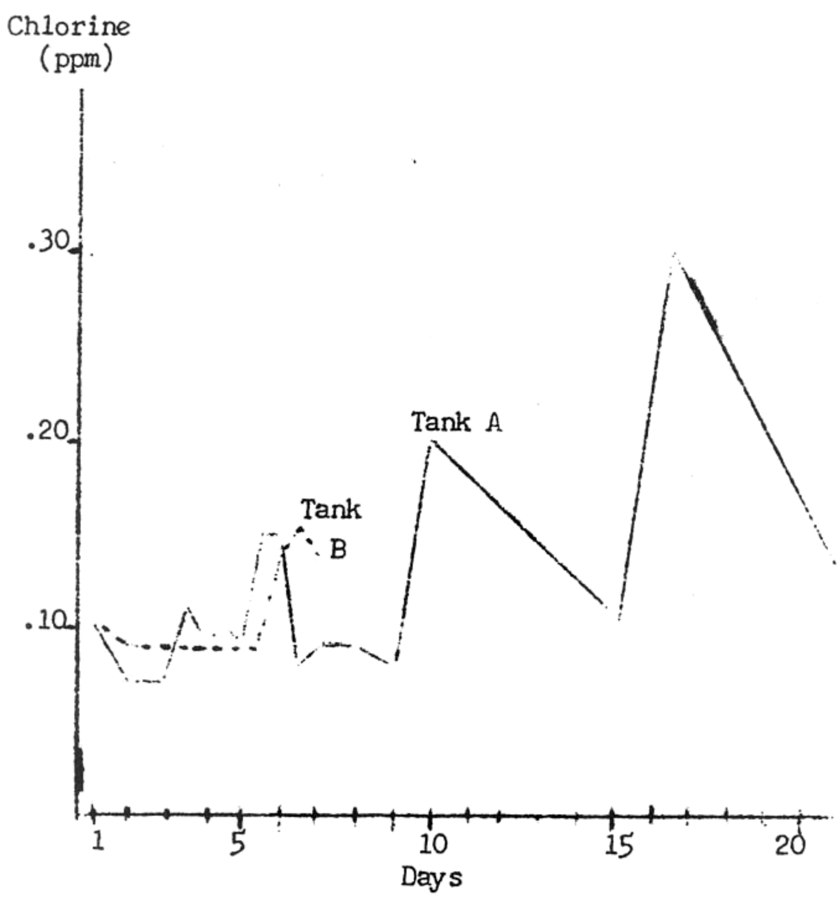
Despite a number of sources that indicate that fishes cannot be maintained with chlorine in the water, it is clear that a certain quantity is tolerated by marine fishes. Sixteen species of marine fishes survived throughout the experiments; and many of these individuals are still living in the display tanks or elsewhere. Some individuals appeared to be more vigorous afterward. Figure 2 gives the residual at the time of death, and the number of days that the fish remained in the tank.

A few additional comments should be made concerning some of the sensitive species found in later experiments. The sea catfish (<u>Galeichthys</u> <u>felis</u>) was found to be much mom sensitive to chlorine than the gaff-topsail catfish (<u>Bagre</u> <u>marinus</u>). The former will move off the bottom and swim in mid-water at less than 0.02 ppm and begin to die when 0.03 ppm is reached. A similar behavior was found for the gaff -topsail, but only when a level of around 0.15 ppm was reached did it die. In these later observations, a number of specimens were involved: 40 sea catfishes and 14 gaff-topsails. Individuals of the same species died at about the same time and level of chlorine. Cobias can adapt to chlorine, but show some peculiar habits when the chlorine is suddenly introduced. They rest on the bottom on their sides for short periods of time.

<u>Literature Cited</u>

Leibmann, Hans 1960. Handbuch der frischwasser und abwasser- biologie. V. II. Munich, Roldenbourg.

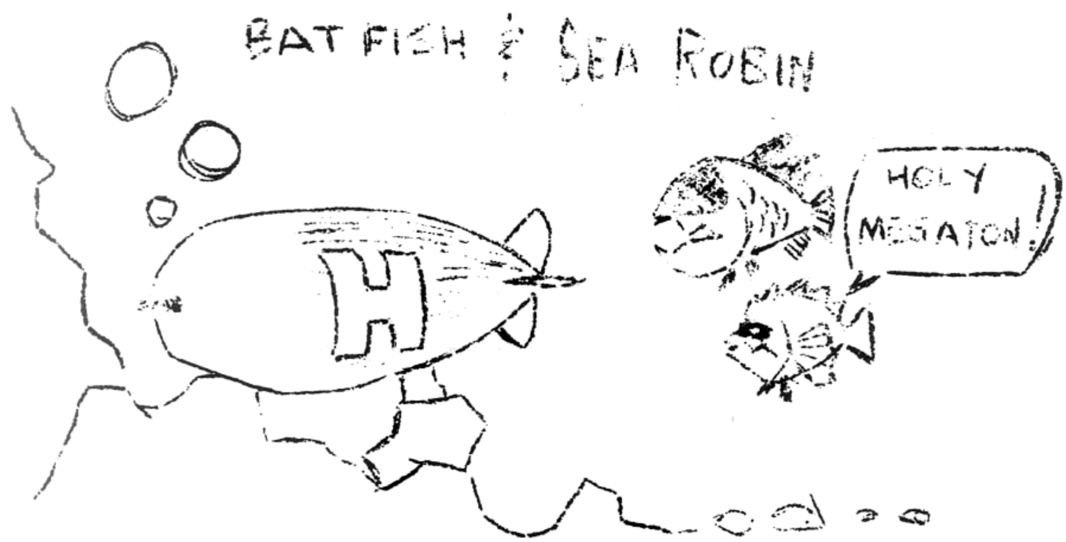
Figure 1. Level of Residual Chlorine in Experimental Tanks Expressed in Ppm*



*Tank A was 200 gals., and contained only Atlantic species. Tank B contained only Pacific species, and held approx. 30 gals.

Figure 2. Data on Experimental Fishes: (1) Days Survived by Fish, (2) Chlorine Level (ppm) at Time of Death, (3) Range of Chlorine (ppm) Experienced by Fish.

Species	(1) Days	(2) Level	(3) Range
Lactophrys tricornis	1-	.07	.07-.10
Trachinotus falcatus	1-	.07	.07-.10
Leiostomus xanthurus	1-	.07	.07-.10
Dasyatus sayi *	6	.09	.07-.15
Dascyllus trimaculatus	6	.14	.09-.15
Amphiprion percula	6	.14	.09-.15
Dasyatus americana	7	.09	.07-.15
Orthopristes chrysopterus	21	.13	.07-.30
Haemulon plumeri	21	.13	.07-.30
Holacanthus ciliaris	21	.13	.07-.30
Dasyatus sayi *	21	.13	.07-.30
Archosargus probatocephalus	Survived		.07-.30
Centropristes ocyurus			"
Chaetodipterus faber			"
Lagodon rhomboides			"
Lutjanus griseus			"
Menticirrus littoralis			"
Micropogon undulatus			"
Monocanthus hispidus			"
Mycteroperca microlepis			"
Opsanus beta			"
Scorpaena braziliensis			"
Sphoeroides spengleri			"



THE BASIC REQUIREMENTS OF A GOOD FISH FEED

Arthur M. Phillips, Jr.
Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service
U. S. Department of the Interior, Cortland, New York

Introductory note: The author of this abstract is undoubtedly the leading U. S. investigator on the nutrition of fishes. The paper was first presented at the Tenth Pacific Science Congress at Honolulu in 1961, but Dr. Phillips has brought it up to date for the occasion. Further information on this vital topic may be obtained from Circular No. 159 of the Fish and Wildlife Service, "Trout Feeds and Feeding" by Phillips, Tunison, and Balzer (1963). It may be purchased for 30 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Do not send stamps. -- J. W. Atz

An animal diet is formulated by the addition of the proper levels of the catalytic and regulatory agents and the supplying of materials for growth and energy. A satisfactory diet is based upon a knowledge of the nutritional requirements of each animal species. Some of this knowledge is known for fish, especially trout and salmon.

Trout food must contain at least 10 members of the vitamin B complex (thiamin, biotin, pantothenic acid, riboflavin, niacin, folic acid, choline, B12, inositol, and pyridoxine). A need has also been shown for the fat soluble vitamins E and K and possibly for vitamin A.

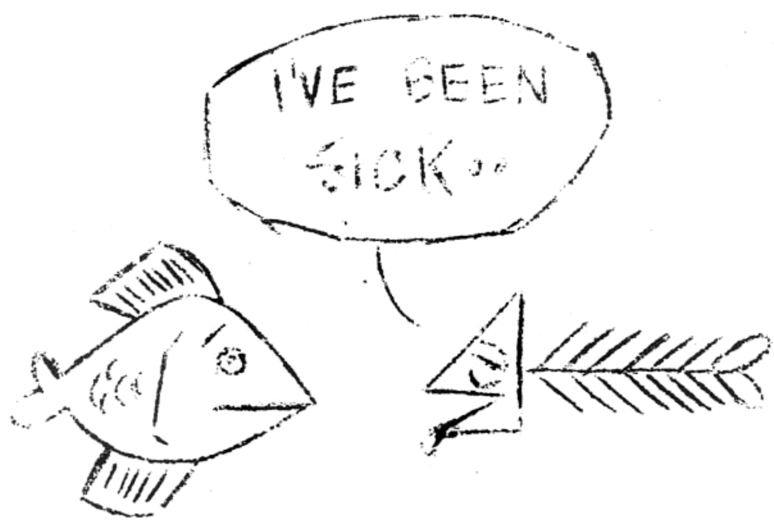
Two sources of minerals are available to fish: Food and water. Many minerals are absorbed by fish directly from water in which they live. The most detailed studies have been made upon calcium. Dissolved calcium absorbed by fish from the water enters into tissue formation. Calcium also serves as an osmoregulatory ion, maintaining mineral balance within fish subjected to environmental changes. In trout diets, only a lack of iodine has produced a specific deficiency symptom (goiter). Nevertheless, it should be assumed that all other minerals essential for higher animals am also needed by fish. Most trout diets contain sufficient minerals, but in areas of mineral-deficient soils, it is advisable to add mineral supplement to fish diets, similar to that used for poultry.

Some fish, such as trout, are poor utilizers of carbohydrate and only limited amounts may be fed. Other fish efficiently utilize carbohydrates. These foods are inexpensive energy sources and should be included in fish diets when possible.

Fats may be fed in limited amounts and serve as energy sources to spare the food protein for purposes that only protein can carry out, that is, growth, enzyme and hormone production, etc. In trout diets the level is kept below 7 percent. Excess dietary fat may cause fatty-infiltrated kidneys and livers.

The amount of protein required per pound of fish produced varies with the diet fed. Approximately 300 grams of protein are needed when trout are fed meat-meal diets containing 28 percent protein; about 240 grams of protein when fed meat diets containing 19 percent protein; and 140 grams of protein when fed natural food that contains 11.5 percent protein. Little can be said about protein quality for fish, but studies have shown that salmon require the same amino acids as the higher animals and, until proven otherwise, this must be assumed to be true for all species of fishes.

Trout fed meat-meal diets, with mom than 700 calories per pound of food, require 2,100 calories to add one pound to their weight; those fed all-dry diets, with approximately 700 calories per pound, require an average of about 1,700 calories per pound of fish produced; those fed meat diets with 450 calories per pound, 1,200 calories; and those fed natural food with 336 calories per pound, 900 calories. About 70 percent of the dietary calories are used for energy, the remaining 30 percent being deposited as protein or fat, or both.



PACIFIC SCIENCE CONGRESS MEETINGS

These meetings, held each fourth year, will be in Tokyo at the end of the summer, 1966. Attempts will be made to schedule some aquarium sessions in order to provide enticement for American aquarists to visit Enoshima, Shimonoseki and some of the other 80 aquariums they have in that country.

Earl Herald

A DIETARY SUPPLEMENT FOR SEA TURTLES

Warren Zeiller, Curator of Fishes, Miami Seaquarium

Seaquarium long has followed a program of accepting juvenile sea turtles from well-meaning persons in the South Florida area. The babies, newly hatched and subject to predation from every angle, are too endearing to be left alone. Laws of human nature overpower those of conservationists and every year shortly after the first full moon in June our laboratory is filled to the scuppers with tiny loggerhead (Caretta caretta) and hawksbill (Eretmochelys imbricata) turtles. Green turtles (Chelonia mydas) less then two days old have come to us from the Ascension Islands, cradled lovingly in a coffee can on the lap of the donor during the flight.

Amid the clamor of seemingly endless feedings, the fortunate babes are reared for one year. By then they are of sufficient size to be returned to the sea in safety; they are too large for marauding gulls, or the tarpon or snook lurking just offshore. Since 1960 some 2500 to 3000 young turtles have been released in this manner.

Some of those raised in the lab were always lost by one perplexing disease. The syndrome of the disease is an encrustation of part or all of the softer body and head areas, particularly about the eyes. The latter eventually caused blindness and death. Other juveniles raised in an enclosing section in our tidal action lake seldom suffered this affliction. All were fed the same fish fillet. Turtles in the lake were observed nibbling on barnacles, etc. in their pen. Those in the lab did not have this calcareous supplement.

Sand of high shell content was placed in the aquarium with the young turtles; apparently having been calcium starved for some time, they dived to the bottom and scooped it up by the mouthful. Pullet Scratch, a readily available and inexpensive crushed oyster shell product, made an excellent substitute for the natural sand. The scratch is placed on the bottom of the aquarium where it is always available to the turtles.

Mortalities in baby sea turtles which have been caused by this dietary deficiency are now a thing of the past. Since inauguration of this procedure all the babies, with exception of those few retained for display, have returned to the sea.

LITERATURE

A. Daugherty Marine Mammals of California. Calif. Dept. of Fish and Game, 1965.

Dolphins and Porpoises. Fisheries Center Leaflet #1, National Fisheries Center,
Washington, D. C.

UNDERSEA GARDENS IN SEATTLE OPENED TO THE GENERAL PUBLIC

Eric Friese, Curator, Undersea Gardens, Seattle

After three years of successful pioneering with the Undersea Gardens in Victoria, B. C., another such unique marine life display has been opened up. As the first such establishment in the United States, Undersea Gardens, Seattle, was officially opened on 19 June, 1965 at Shilshole Bay.

Basically the Undersea Gardens consists of a modified ship's hull, 100 feet long and 32 feet wide, with 112 large viewing windows (18 by 36 inches - 8 inches apart) below the water line. Large triangular alcoves with 4 windows on each side protrude from the hull into the display area. The actual display area is constructed in the following manner: From the outside of the hull a 15 foot steel ledge (about 7 feet below the surface) extends outward around the entire hull, and ends in an 8 foot high plexiglass panel fence. The panels are held in place by strong steel braces, spaced on the average about 6 feet apart. For easy maintenance (i.e. the removal of algae, barnacles, etc. and to replace a possible broken panel) these 1/4 inch panels slide in and out in small grooves on each side of the steel braces. As further support for this plexiglass fence, the upper part, which is about 2 feet above the surface, is built into a mall "cat walk". A small gap in the center, running lengthwise, permits the removal of the plexiglass panels.

This "fence" surrounds about 3500 square feet of bottom in natural sea water. The entire structure (referred to as a "vessel" in expert circles!!) floats, i.e. it rises and falls with the tides. It is held in place by two sets of moorage pilings with an I-beam guide post on each side. The visitors come "aboard" over a gangplank, and descend beneath the sea level by walking down a stair well to the submerged, air-conditioned viewing room. An important factor in the uniqueness of this exhibit is the tremendous panoramic view afforded the visitor. Rather than looking into individual small tanks, as presented in the conventional public aquarium, the visitor is completely surrounded by one continuous enclosure, featuring an entire cross section through the various habitats of marine life found in Puget Sound. With such a gigantic display area to fill, heavy emphasis is placed on large, natural rock reefs, kelp beds and well designed fiberglass octopus caves, which are camouflaged to blend in perfectly with the surroundings.

In order to permit viewing at night, 72 powerful underwater lights with over 20,000 watts of flood lighting are installed. Well trained guides in the viewing room give regular guided tours, during which a Scuba-diver on the outside in the display area brings up specimens to the windows for close-up viewing.

Compared to the technical problems occurring in a conventional open or closed-system aquarium, those present in the Undersea Gardens type operation are insignificant. In contrast to the vessel in Victoris, B. C., where a wire screen permits constant flow through and mixing of fresh salt water from the outside into the display area, two pumps are used to supply high salinity water in Seattle. This is done to avoid the low salinity and highly polluted waters from the adjacent Shilshole Marina and the nearby Lake Washington fresh-water run-off. The water is pumped into the display area at a constant rate, and the excess water diffuses out again through the many small gaps around the plexiglass panels. Just as a matter of comparison: The incoming water has a temperature of 12.5 to 13.0 degrees Centigrade and a salinity of about 31.6 parts per thousand. The Shilshole Marina water has a fluctuating temperature of 15.0 to 17.5 degrees Centigrade and salinity readings indicate from 26.0 to 28.6 parts per thousand.

The largest biological problem is the same as that of a home aquarist with a community tank - compatibility among the inhabitants. This immediately eliminates many of the smaller intertidal species of fish and invertebrates, but at the same time affords a unique opportunity to display large fish and large schools of fish. An ideal balance could be achieved by installing a number of small individual tanks for the smaller specimens. This is one of the proposed improvements that should be considered in future Undersea Gardens to be built.

The tremendous appeal that this type of marine life display has to the general public is the actual descent beneath the sea, and the feeling of being completely surrounded by the boundless continuity of the open ocean with its multitude of marine life. Without having to don elaborate and awkward diving gear the visitor can come face to face with many of the fascinating creatures of the deep and thus be his own adventurer a la Mike Nelson!! This is exactly the atmosphere and feeling that is conveyed to most of the visitors, and which draws them back again and again to the Undersea Gardens. Judging from the initial success, i.e. the enthusiastic response from the general public, this type of advanced marine life display might very well replace many of the conventional aquariums to be built in years to come.

NEW ADDRESSES

David H. Brown - Seaquarium PTY Ltd, Southport, Queensland, Australia

David C. Powell - Sea World, San Diego, California

Don Zumwalt - John G. Shedd Aquarium, Chicago, Illinois

Paul Montreuil - has left New York to build a new aquarium in Montreal, Canada

Bob Morris - formerly with Honolulu and Marineland of Florida, has joined the staff at New York Aquarium

What ever happened to Lee Finneran?

MAINTENANCE PROBLEMS IN LARGE PUBLIC AQUARIA

Frank de Graaf, Curator, Aquarium and Reptile House, Natura Artis Magistra

Introductory note: This is the abstract of a paper presented at a symposium on wild animal management that was held in Holland in 1962. It was not published until late last year, however, in the Archives Neerlandaises de Zoologie, Vol. 16, No. 1, pp. 142-143. Its author is in charge of the Amsterdam Aquarium. His studies on the chemistry of aquarium waters ought to be emulated by other aquarists. Curator de Graaf is continuing these important investigations, and he considers the observations recorded below as only preliminary. - J. W. Atz

1. Maintenance of a closed seawater circulating system

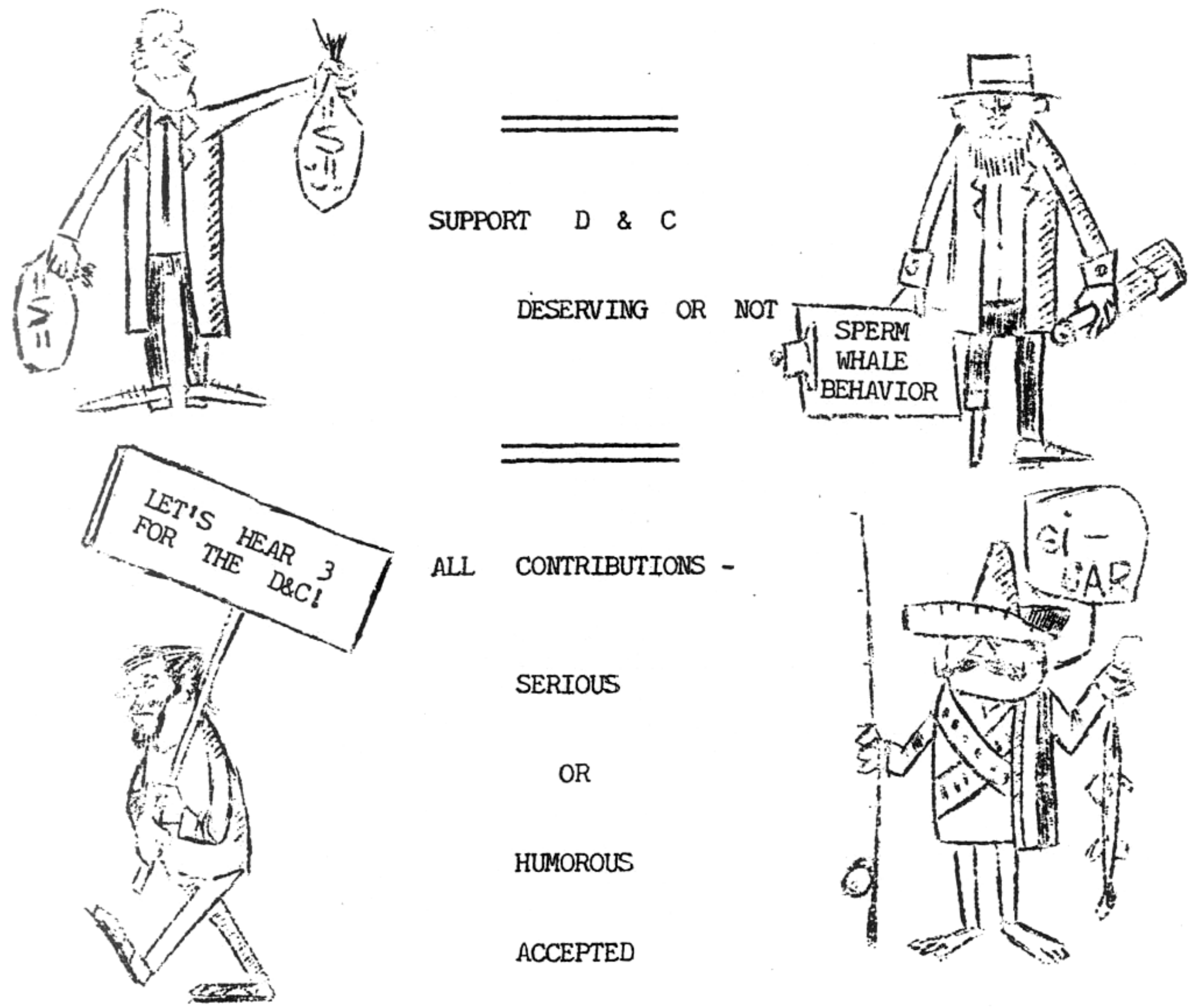
The problems center around the measures which have to be taken to establish optimal conditions for the marine animals in captivity. These measures include pH-control, 0_2- and $C0_2$ control. To reach a certain natural equilibrium in a seawater system it is necessary to care for an intensified bacterial breakdown of the large amount of organic waste-materials produced by the animals. Mineralization of the circulating water takes place in large sandfilters. pH control and $C0_2$ control is effected in large filter compartments filled with broken seashells, which serve as a source of calcium. The water leaving the filtersystems has to be aerated vigorously, as nearly all 0_2 is consumed in the filtration process. Although complete mineralization of the water may be realised in the filtersystems, a natural equilibrium cannot be reached in a closed system, because of the fact that the endproducts of the breakdown of the organic material are not completely taken up by the plants. In this way a slow accumulation of inorganic salts takes place, which in time makes the seawater unsuitable for the sustenance of living animals. So the concentration of inorganic salts has to be watched carefully: NO_3 serves as indicator. Some invertebrates (Pagurus bernhardus) show already discomfort at NO_3-concentrations of 75-100 mgr/L. At levels of 250-350 mgr/L many fishes die. To slow down the accumulation of NO 3 and other salts, the growth of algae in the aquaria is stimulated, which has a marked success.

Beside the accumulation of inorganic salts another chemical constituent of the seawater is thought to be an important agent in the so-called "aging" process of the circulating seawater. This chemical constituent is not known, but is believed to be some organic compound which is not broken down and which is further responsible for the yellow-brown colour of "aged" seawater. By removing this colouring from the water, this water is again made suitable for sustaining aquatic life. To minimize the chemical changes in the aquaria brought about by the activity of the animals, the rate of flow of the water through the aquaria has to be as large as can be realised with the existing installation. Additional aeration is necessary in the large seawater tanks.

2. Maintenance of a closed freshwater circulating system

Freshwater in a closed system undergoes also an aging process, which in time makes the water unsuitable for aquatic life. Beside the accumulation of inorganic salts there is probably also an organic agent involved in this process. As more aquatic plants can be cultivated in freshwater than in seawater, the maintenance of a freshwater circulating system is easier than that of a seawater system.

3. Disease control
Control of diseases of fishes is a very important aspect of the aquarium maintenance. Fishes in captivity are very susceptible to a large number of protozoan and bacterial diseases, some of which are highly contagious. Every new fish is kept in quarantaine for a rather long time to try to avoid introduction of parasites in the circulating systems. Identifying and treating fish diseases is not easy, especially those of marine fishes, as little is known about these. Curators of public aquaria are for ever pioneering in this field. To combat diseases of tropical marine fishes, which on the whole are highly susceptible animals, we have installed an experimental ozonisator in the pressed-air installation to bring about a partial disinfection of the water.



A TANK FOR EXHIBITING TIDE POOL INVERTEBRATES

Daniel H. Moreno, Director - Curator, The Cleveland Aquarium

A tank for exhibiting tide pool invertebrates has been designed, built, and put into operation recently at The Cleveland Aquarium. Though none of the features of this exhibit is new, we believe the combination to be unique as well as practical. The exhibit-water receptacle consists of an 18-gallon fiberglass laundry tub with a row of plastic-screened holes just below the upper lip. This container is supported by its flange resting on a ledge in a larger tank.

This larger tank is constructed of one-inch exterior-grade plywood, coated on the inside with a non-toxic paint[1] and screwed together with counter-sunk screws. All corners are sealed with a generous bead of Silastic[2]. Viewing is from above, in this case through a circular hole in the removable lid, with glass on top.

Light is provided by two 25-watt incandescent showcase bulbs in rubber-base sockets attached to the back wall of the plywood tank a few inches above the level of the fiberglass insert tank[3].

The entire bottom of the plywood tank is provided with a fiberglass sub-gravel filter. This was made from a fitted piece of corrugated fiberglass slotted by running a circular saw, set for a shallow cut, across the striations. The filter bed is composed of coral gravel or crushed oyster shell in order to provide entrapment of particulate matter, biological filtration, and automatic p-H control by the buffering action of the calcium-magnesium-carbonate. Filtered water is pumped from below the filtrant by means of a ¾" air lift. This tube can be fashioned easily from an appropriate length of unplasticised P. V. C.[4] bent into an inverted "J" shape. For most efficient operation, air injection should be mar the bottom of the airlift tube and through a ring of 1/16" holes drilled about the air lift pipe within a plenum. Such an air injector may be quickly and easily made by slipping a short length of one-inch P. V. C. pipe over the holes and sealing the area by means of two circlets of air line, which may be further air-proofed with a coating of Silastic. The single air line is then fed into the one-inch plenum pipe.

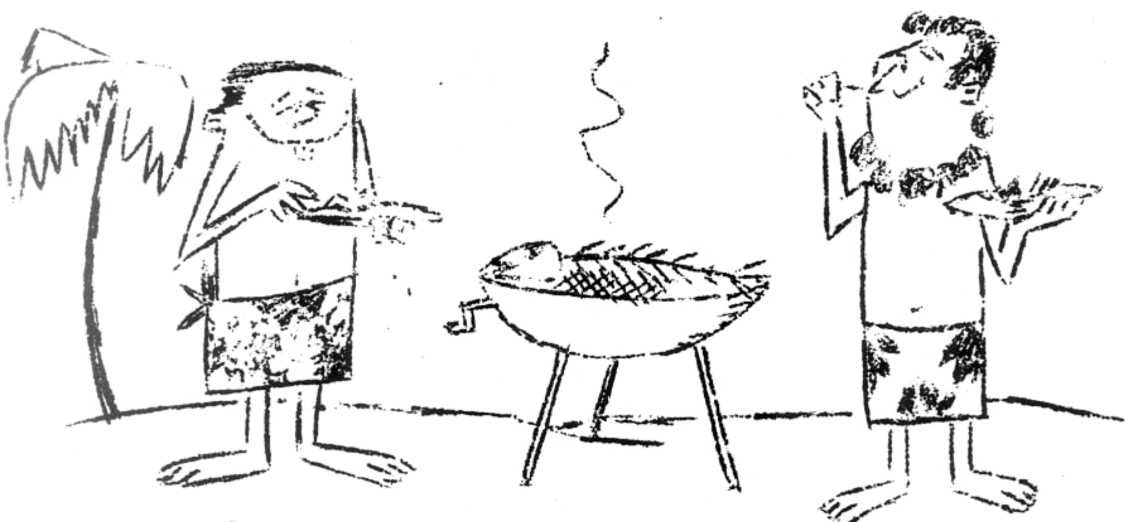
By carefully directing the discharge and adjusting the flow rate from the air lift, the animals in the fiberglass tank will be bathed constantly in freshly-filtered water and clearly visible below the gently rippling surface. Splash barriers to protect the bottom of the viewing glass were fashioned from scraps of fiberglass and attached to the bottom of the lid.

Viewing from above, as into a tide pool, has been found to be a most satisfactory way of exhibiting many invertebrates-- particularly those which are radially symmetrical. We envision that a similar setup on a larger scale would be a good way to show fishes such as flounders and rays.

(Continued)

Probable photograph of Cleveland's tide pool was too degraded
to reproduce from the multiple-generation photocopy used
to archive this issue of D&C in 2004 by PJM.

1. Tile-it: McDougall, Butler & Co., 2929 Main St., Buffalo 14, N. Y.
2. Silastic: Dow Coming Bathtub Caulk, or Building Sealant #780 or #732. (General Electric Silicone Product Sealant R.T.V. #2562-O1D may be used.)
3. Fluorescent tubes could be used instead, attached to the bottom of the lid, with the wires running outside the case to the starters, transformers and plug.
4. Polyvinyl Chloride.



LAST OF THE RED HOT MAHI-MAHI'S

A BELUGA FROM ILE-AUX-COUDRES FLIES TO BRITAIN

Gaston Morin, Director, Quebec Aquarium
(Department of Industry and Commerce of Quebec)

The arrival of a Canadian baby beluga (or white whale) in England on November 10, 1964, created almost as much of a stir as Rudolf Hess's unexpected visit some twenty years earlier. However, "Titch", a gift from the Quebec Aquarium, was not going into prison, unless you were to apply such a term to "Flamingo Park", the zoo near Manchester where a specially built container was waiting for the animal.

One morning last October, a young beluga - no doubt driven by the curiosity which is one of the characteristics of its race - escaped its mother's vigilance to take a closer look at the world of man. The escapade ended badly for the beluga, for it got stranded near Ile-aux-Coudres and was soon captured by local fishermen. Even so, the "bleuvet" - the name given to baby belugas by the fishermen - was a lot better off than its ancestors whose fate it was to be turned into leather or lubricants. Nowadays, belugas are worth more alive than dead, for zoological gardens and aquariums are only too anxious to have them. The Ile-aux-Coudres fishermen knew that the Flamingo Park Zoo was looking for a white whale. The previous June, one of the Zoo's officials, Reginald Bloom, had paid a visit to the Aquarium of the Quebec Department of Industry and Commerce. I had had the pleasure of accompanying Mr. Bloom on his visit to Ile-aux-Coudres, where the fishermen promised him to keep the first beluga they landed for his zoo in Yorkshire. As soon as Mr. Bloom learned that a baby beluga had been caught, he arranged for its transportation and for the fitting up of suitable quarters. The Flamingo Park Zoo immediately began to build a 22,000 gallon tank and a week later Mr. Bloom arrived in Quebec.

Under the supervision of experts from the Quebec Aquarium the beluga was taken by truck from Ile-aux-Coudres to Quebec and installed in a private swimming pool in Ste-Foy, a suburb of Quebec City. The water in the pool had a salinity of 16‰ and its temperature was kept at 50˚ F. Titch immediately took to its new surroundings. One week after its arrival, the beluga got its first meal. As the baby beluga had only recently left its mother, it had not yet learned to feed itself and had therefore to be tube-fed with a mixture of ground herring and clam, cram and vitamins. The young animal, which showed a healthy appetite and a good deal of energy, was now ready to travel. Everything was done to make Titch comfortable during the long journey. For the trip a special container had been built of wood lined with foam rubber and plastic. Plastic bottles filled with ice were placed in the water to ensure an even temperature. The plastic bottles were used to prevent the ice from melting in the water, as this would have affected the pH and the salinity of the water.

Comfortably installed in its new abode, the precious specimen was taken by truck from Quebec to Dorval where it was put on the 'plane for England. The 'plane was a specially chartered Super G Constellation belonging to Air France. While everything possible was being done to ensure Titch's well-being, the officials and journalists accompanying the beluga were not forgotten either. Although the Super G Constellation was a cargo 'plane, it offered all the advantages of the company's passenger 'planes. We had with us two members of the CBC film unit who were there to film "Operation Beluga" from beginning to end. The last questions of the many newspaper, radio and T.V. reporters who had come to see Titch off were drowned by the noise of the turbojet engines of the 'plane which took off at 3:30 p.m.. The take-off was perfectly smooth and Titch remained quite undisturbed.

The 'plane headed eastward, flying at a height of 15,000 feet and at a speed of 310 miles per hour. Canada was receding in the distance and forests and mountains were merging in the growing darkness. Not that it made much difference to us; we hardly had time to admire the landscape, we all watched Titch. The animal was being kept under close observation; its breathing and body temperature, the temperature of the water and the pressure of the air were constantly checked.

Our only stop was Gander, where we touched down to lay in a supply of ice, oxygen and salt needed for Titch. At Gander, Air France had a 22,000 gallon tank ready, in case the beluga needed a change. However, Titch showed no sign of fatigue. At 8:30, an hour after we had touched down, we took off for the second and longer part of the journey. Only the flames of the turbojet engines were visible through the windows.

It was rather chilly on board. The temperature was kept at 46˚ to 49˚ F, as 50˚ F is the maximum temperature compatible with a beluga's comfort. The water temperature was kept at 47˚ to 54˚ F. The beluga remained calm and its breathing was normal (four to five respirations per minute). During the trip, penicillin ointment was applied to the two deep wounds Titch had received on the journey from Ile-aux-Coudres to Quebec. From time to time, water was poured over the beluga. The water's pH and salinity were kept at 7.4 and 18‰ respectively throughout the journey.

Suddenly we found ourselves in an air pocket: it was as though the 'plane was being sucked down, a breathtaking sensation which left our ears buzzing. Unlike Titch, however, we were none the worse for it. Titch took it less well. The animal's breathing became faster: we counted four to twelve respirations per minute. Mr. Bloom's face reflected the anxiety we both felt: Was Titch going to die while we looked on helplessly? Had all the trouble taken in catching the animal, looking after it and arranging this journey been in vain?

No effort was spared to save Titch. In order to prevent the animal from drowning, we supported it in the water. We also massaged it lightly. Twenty minutes later, its breathing was back to normal and it seemed to be out of danger. Unfortunately, we hit another air pocket. The animal was again unwell but responded to the same treatment we had given it before.

Through the windows we could see the first streak of dawn, though the darkness was still hiding the ocean below. All through the trip Titch was kept under constant observation. The temperature of the water was checked 73 times and the animal's breathing 66 times.

At last, we were landing! While Canada was still asleep, dawn was breaking over Europe. Through gaps in the clouds we could see the green fields of England and, half hidden by the mist, Manchester. Again, we had a perfect landing. The trip had taken six hours, but it was now eleven hours since we had left Montreal due to the five-hour difference between Montreal and Greenwich time.

At Manchester, a tank containing 20,000 gallons of salt water waited the honoured guest. Titch appeared to be fit and ready to start on the last leg of the journey. The Zoo's truck, accompanied by a motorized escort of county police, took Titch from Manchester to Malton. With the help of two divers, the Zoo's new boarder was immediately put into the tank that had been built for it. The salinity of the water was reduced from 24‰ to 18% in order to make it easier for the beluga to romp about in the water but, after frisking about a bit, it seemed tired. Two zoo keepers had to hold up Titch all through the night to prevent the animal from drowning. The next morning the beluga had its first meal since leaving Canada: 1,500 cc of ground herring and clam in cream, by courtesy of the Quebec Aquarium. The following meal created difficulties. Nowhere in England was it possible to find the type of grinder-mixer that had been used in Quebec to prepare Titch's meals. A news agency immediately put out a call for such a machine and a Canadian factory dispatched it to England by air. In addition, a European firm sent the Zoo a ton of clams.

Soon after its arrival at Flamingo Park Zoo, the young beluga seemed to have completely recovered from the strain of the journey. Playing by itself in the water, the animal was enjoying its food and taking no notice of the many visitors who came to see it.

Unfortunately, only a few weeks later, the beluga again showed signs of ill health. Specialists were called in and still greater care was taken than before. All the resources of modern science were mobilized to save the beluga life but it died, plunging Flamingo Park Zoo into deep mourning. Newspapers all over the world carried the story.

Despite this sad end, the attempt will not have been in vain. The experience gained, as well as the results of the autopsy, will prove extremely valuable when two more belugas are taken to the United Kingdom this summer. Pentland hick, the director of Flamingo Park Zoo, intends to try again. In the spring, the Ile-aux-Coudres fishermen will try to catch two more belugas which will be sent to Great Britain; a huge 200,000 gallon tank is awaiting them at Scarborough, not far from the Zoo. This export experiment was part of a large-scale exchange programme of fish and mammals between Manchester and Quebec. The Quebec Aquarium also sent the Manchester Zoo two young harp seals, a longnose gar, a bowfin, and two sturgeons.

ANSWER: On January 14, 1966, Don Hackett, Marineland's artist, noticed that the small two-spot octopus (Bimaculatus) on display in one of our small tanks had laid a large cluster of eggs. He then dropped two mall hermit crabs into the tank with her, which she ate immediately. Since that day, she has eaten several hermit crabs, at least two dozen live goldfish and many Small pieces of white bait. She will actually leave her eggs to get the food. On two occasions, we found eggs way from her, which she took back and cleaned immediately. I am writing this on the 24th of March, 1966. The eggs have not hatched but look in very good condition. We know of no other octopus which has eaten regularly after laying eggs and are interested in hearing if anyone has had a similar experience.

Jerry Goldsmith