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VOL. XIV, NO. 1, MARCH 1968

OCEANUS

ON THE COVER—


jl

Bad Winter

It has been such a severe winter in our area that we decided to use a tropical view on the cover to provide a ray of hope to readers in cold climes. The view is the downwind beach of Aruba in the Netherlands Antilles. Barely visible is the R.V. 'Crawford' setting out to sea.

Those of our readers living in warm surroundings may take pleasure in the condition of our "front yard" shown on this page.

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

Jan Hahn, *Editor*
Priscilla Moniz, *Circulation*

Published quarterly and distributed to the Associates, to Marine libraries and universities around the world, to other educational institutions, to major city public libraries and to other organizations and publications.

Library of Congress Catalogue Card Number: 59-34518

COVER PHOTO BY jl

Vol. XIV, No. 1, March 1968

Henry Bryant Bigelow

1879 - 1967

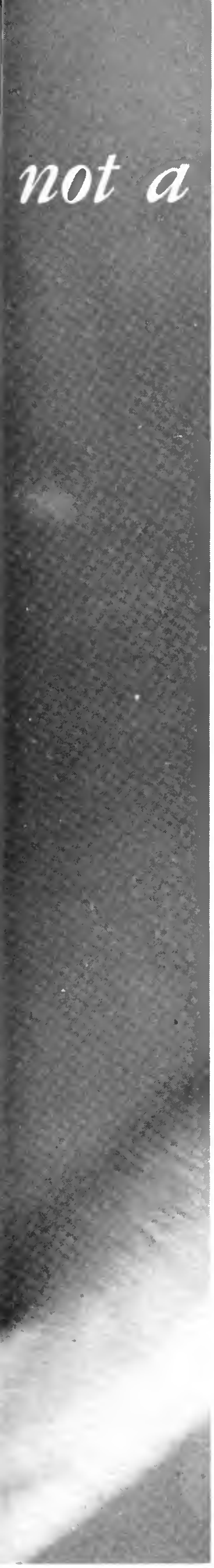
To our great grief,
we lost our Founder Chairman
in the 88th year of his life.

A special issue of "Oceanus",
dedicated to Dr. Bigelow, is in preparation.

Man is

"Breathing is accomplished in a second as a blowhole momentarily breaks the surface."

Note the closed blowholes in the porpoises swimming just below the sea surface.



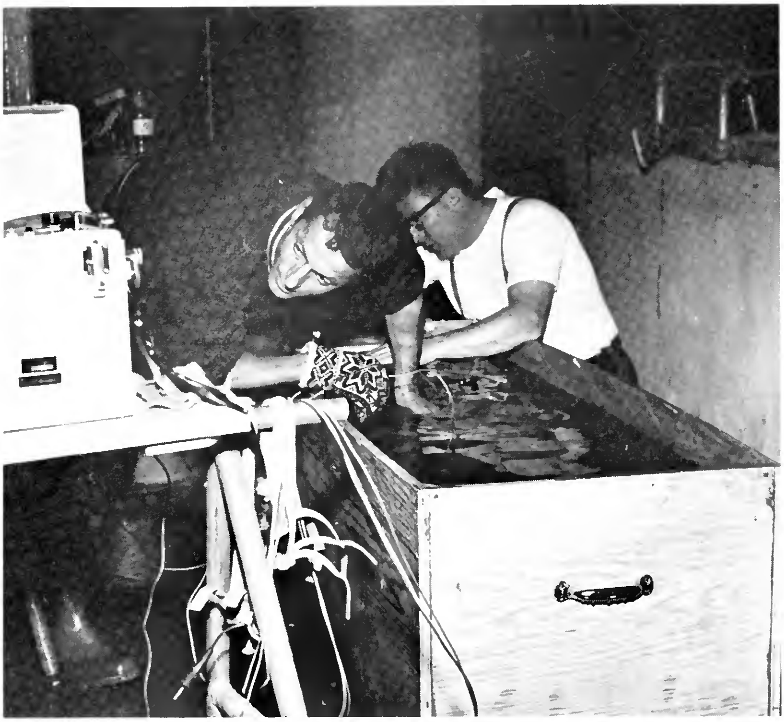
not a seagoing animal

by J. KANWISHER

MAN'S increasing desire to move about in the sea has aroused interest in the question how porpoises and whales (cetaceans) perform so well under conditions which seem hostile to man. The whales as mammals must meet the same conditions of breathing air and maintaining a high constant body temperature. Yet, they are at home in both polar and tropical seas, while some can dive nearly a mile down and stay down for one to two hours without a new breath of air. A human diver, even with a lot of fancy engineering strapped to his back, cannot begin to approximate this feat.

Human contact with these animals in nature usually is brief and dramatic. Much of oceanography consists of uneventful periods of waiting while the ship steams along between stations. But the somnolent spell can be quickly broken by a call from the bridge: "Porpoises!" Despite their previous exposure, most scientists will rush on deck with cameras and binoculars. The sightings of porpoises and whales are a welcome relief from the tedium that makes up much of seagoing life.

Thus, anyone who spends time on oceanographic vessels has many chances to lean over the bow and look down on porpoises, who appear to get a free ride on the wave pushed up by the advancing ship. Breathing is accomplished in a split second as the blowhole momentarily breaks the surface. Any given individual may swim off ahead of the ship to have his place taken by another. In this manner it is not uncommon to have hundreds of animals attached to the ship much like the neighborhood dogs around the postman. At an instant they may scatter as they respond to some urge or whim about which we know so little. It is easy to understand the mystic attachment sailors, from the Greeks onward, have given these animals. Envy and wonder are natural reactions.



The author, assisted by G. Sundnes of the Bergen Fisheries Laboratory, measuring the heartbeat of a porpoise submerged in the "emergency aquarium."

The underwater telemetry gear attached to the waist of a diver is so small that he usually is not conscious of it being there. The diver cannot hear the signals.

Measuring the total metabolism of a diver by way of respiratory gas exchange. The diver has to swim to keep up with the visual target at left. He receives no push from the breath collector which is attached to a turntable running along the tank.

The sight is even more impressive to the physiologist. Mixed with his esthetic envy of such grace and speed is the curiosity of how internal function has been altered to allow such performance.

In my case at least, even after a decade of studying the physiology of these animals, I still run on deck when a sighting is called down from the bridge. But the bow of a ship traveling at 12 knots is no place to study the respiratory or temperature physiology of these animals. However, with strategy and patience it has been possible to study a captive animal in a laboratory situation.

From such work it has been possible to observe some of the physiological adaptations which make cetaceans better fitted to the trying conditions of life in the sea. For example, the heart always slows down when a porpoise holds its breath, as it must do during a dive. This is believed to be crucial to understanding how the animal stretches out its limited oxygen supply while swimming below the sea surface. But the conditions of a laboratory experiment, with the animal held on a stretcher in a tank of water, are far removed from those in nature. We had to know if a porpoise behaved in a similar fashion in the ocean.

Telemetry

The usual way to follow action at a distance is via a radio-link between the subject and the experimenter. But sea water heavily absorbs radio energy. For any practical range it is necessary to use sound, to which water is most tranparent. Therefore, it was necessary to develop a skill in acoustical telemetry which made it possible to monitor an animal swimming free at a range of several miles while continuously sending back information on his temperature, heart rate, swimming speed, and depth. A year of equipment development produced a pillbox-sized package of transistors and batteries. This was fastened to the side of a porpoise. The original question of the porpoise heart rate was answered in a few minutes. The heart did beat more slowly whenever the free-swimming animal dived voluntarily.

Getting the porpoise proved to be more difficult than building the telemetry gear. For physiological reasons, I wanted a small species in cold water. This was finally obtained from a Norwegian fisherman who answered an ad in a newspaper. The difficulties of keeping and working with these animals were overcome only by liberal help from the Norwegian Navy, the Fisheries people, and even the Bergen police who loaned us a casket as an emergency aquarium. Since that time the transmitters have been attached to a variety of porpoises, seals, and small whales and all have shown this same lowering of heart rate while diving.

Use for man

After the telemetering method had been in use for several years we realized that no comparable measurements were being made on human divers. This was painfully brougt to my attention by two fatal accidents involving scuba gear. In both cases the cause was never determined and the bodies were found only after prolonged search. It seemed that a relatively cheap sound transmitter, such as used on animals, might have told what went wrong. Impending trouble might have been avoided. And, if the diver's heart beat and breathing had stopped, one could at least find the body by following the sound signals. With this as a spur, the telemetry work has been extended to man. Part of the aim of the animal work had been to determine why man, in comparison, is such a poor performer. Both intellectual and practical drives are satisfied by the extension of the work to man.

Signals

It was a simple task to convert the telemetry gear to human use. Body temperature, important in the animal studies, was not as necessary for our studies of man. This was traded off for breathing. A thermistor in the mouthpiece alternately is cooled and heated as air from the scuba tanks and expired breath pass over the thermistor. This produces a tone in the receiver which rises and falls in pitch reminescent of the sound of an air raid alarm. With this signal one can readily tell any irregularities in breathing. If the mouthpiece is lost accidentally by the diver, the constant temperature of the water on the thermistor sends a steady signal which promptly indicates to the surface observer that the diver is in trouble. Superimposed on the breathing tones are little bleeps indicating the heart beat which is detected by suction cup electrodes on the diver's chest. Depth is indicated by the long term average of the signal frequency, and speed is included by a process that is not directly audible and so does not confuse the observer on the surface. This involves a small propeller which turns while the swimmer moves ahead. A magnet attached to the propeller shifts the signal frequency a small amount.

The received signal only has to be listened to. This makes it possible for one man to monitor a diver while giving most of his attention to other things, such as running a boat. Esthetics have been sacrificed in an effort to leave the observer's eyes free. The resulting signals, although easy to interpret as to the well being of the diver, sound like someone learning to play the violin. The sounds, of course, can be recorded on a magnetic tape for future use.

The telemetry transmitter in no way interferes with the diver as it is only 3 by 20 cm, weighing 200 grams, usually attached to the air tanks or hung from the weight belt. Usually the diver is not even conscious of its being there. The diver cannot hear the underwater signals as the sound frequencies used are 30 to 40 kilocycles, well above human hearing. The records from one swimming season provided in reliable detail some of the respiratory features of a free diver in underwater action.

Gas exchange

For some work it was necessary to have the diver take occasional gas samples from the mouthpiece with a syringe. The samples were brought to the surface for analysis. Such data provide some of the details of respiratory gas exchange in the lungs at depth, under the unnatural high pressure conditions which are unique to a man venturing into the water. For instance, it appears that the greater amount of oxygen in the air entering the lungs, relieves somewhat the urge to breath again, so that the respiratory rate is slowed. This results in a build up of CO_2 in the lungs to what may become a critical level. A recent naval accident involved a diver who became unconscious at depth. This could have come about in such a fashion. Both he and his buddy died of the bends, when the latter tried to save his friend by bringing him quickly to the surface without decompression.

DR. KANWISHER is a senior scientist on our staff. He is primarily interested in the physiology of animals, including man.

Ventilation

The pressure, and therefore the amount, of air remaining in the tanks can be telemetered separately. This tells the total ventilation, or the amount of air that has passed through the lungs. Since the number of breaths is also known from the mouthpiece sensor, the volume of air per breath (tidal volume) is known. Such measurements on actual divers show that this volume decreases somewhat with depth. The greater viscosity of the air under pressure increases the physical work of breathing. Apparently the body's response is to try and avoid some of this increase. Both the greater amount of oxygen and greater viscosity operate in combination to produce the lower ventilation and consequent build-up of CO_2.

It is interesting to try and find in the data some answers to why man is such a poor diver without his scuba gear. The reduction of heart rate with diving has already been mentioned as one aspect of how the cetaceans extend the time between breathing. The limited supply of oxygen in the lungs and blood is used principally for the vital functions of the heart and brain. Without oxygen both of these organs cease to operate within seconds. But the rest of the body is remarkably resistant to temporary anoxia. One learns in Boy Scout first-aid for instance, that wound bleeding in an arm or leg can be stopped for 15 minutes by a tourniquet. During most of this time the limb is anoxic and yet little harm results. Thus the marine mammals can cut off the circulation to much of their body and temporarily save oxygen. Since the circulation is reduced there is no need to keep the heart beating as fast.

Some workers have sought for analogous human data. When a prone man in the laboratory immerses his face in a dish of cold water he shows a varying amount of heart rate reduction and reduced blood flow. This has been interpreted as being a whale-like diving response. But the more important question is whether a significant oxygen saving is effected and here the numbers do not hold up. My measurements on divers in the water indicate that the body is very little, if at all, starved for oxygen during breath holding. Consequently the human uses his reserves more rapidly and must breath again. It appears that man's circulatory system cannot be as abruptly controlled as that of a porpoise.

Avoid trouble

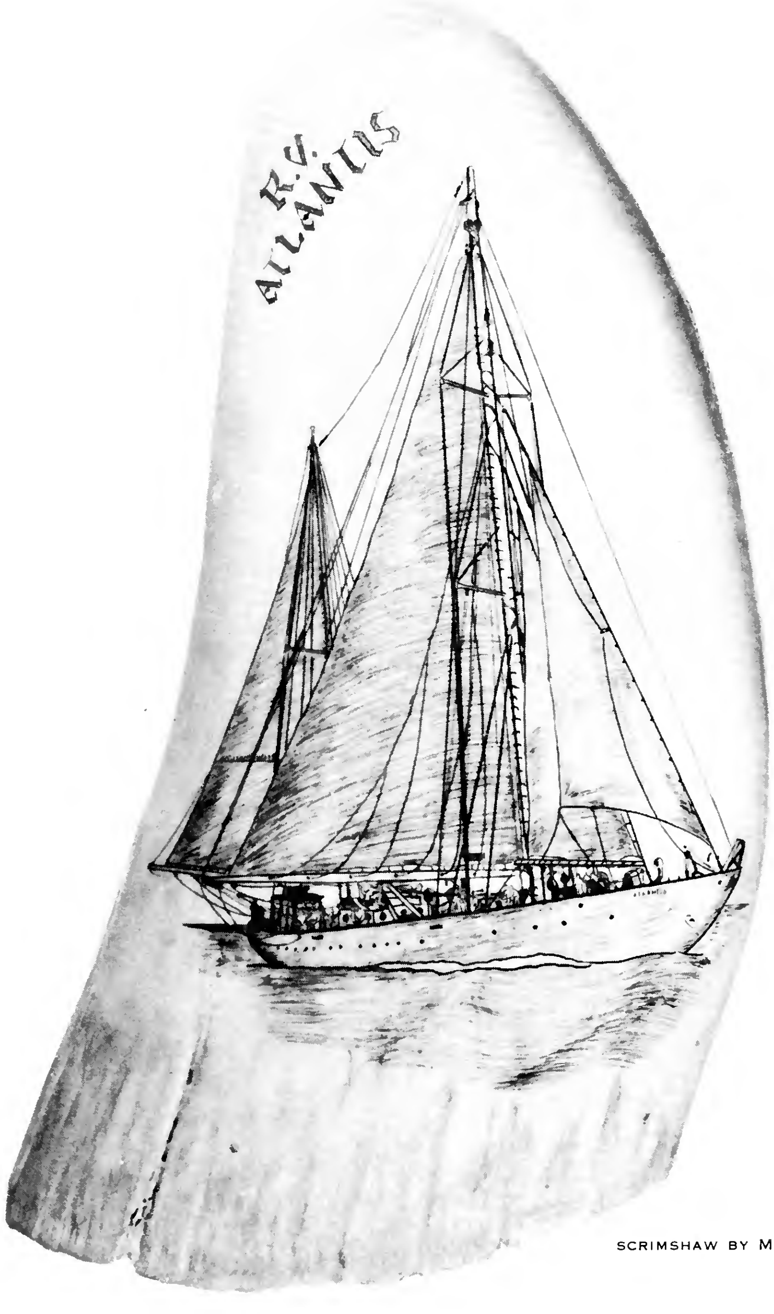
The operational features of diving, such as losing direction, malfunction of equipment, etc., in addition to physiological limitations, make diving a hazardous venture. But it is hoped that a better understanding of human capacity and function will avoid some potential troubles. A trained person on the surface can quickly detect any irregularities in heart beat or breathing of the diver which may indicate an impending crisis. To help the diver, it will be necessary to have some acoustical link down to him. To help in the other direction, the telemetry transmitter is fitted with a key which can be used for signaling to the surface.

Optimistic predictions are made frequently of man exploiting the sea for "unlimited riches of food and minerals." Pictures are shown of large bubble habitats sprinkled across the sea floor. Men venture forth with scuba gear or midget submarines. Such dreaming is uninhibited by practical considerations of either physiology or engineering, apart from the fact that many oceanographers do not believe the "riches" exist. In body at least, man is a frail beast and much more needs to be known about his weaknesses. For the present, divers are going into the sea with scanty empirical knowledge and without proper safety features. Diving always may have to appeal to the brave. It should not also have to apply to the foolhardy.

FROM THE COLLECTION OF R. GUILLARD

Hazards to human divers may lead to rapid breathing and increased heart action.

SCR



SCRIMSHAW BY McLAUGHLIN

"Throughout the Pacific, and also in Nantucket, and New Bedford, and Sag Harbor, you will come across lively sketches of whaling-scenes, graven by the fishermen themselves on Sperm Whale-teeth, or ladies' busks wrought out of the Right Whale-bone, and other like skrimshander articles, as the whalemen call the numerous ingenious contrivances they elaborately carve out of the rough material, in their hours of ocean leisure. Some of them have little boxes of dentistical-looking implements, specially intended for the skrimshandering business. But, in general, they toil with their jack-knives alone; and, with that almost omnipotent tool of the sailor, they will turn you out anything you please, in the way of a mariner's fancy."

Moby Dick

IMSHAW

The old art of scrimshaw has been revived on board our research vessels.

by J. HAHN

IN the long hours, days and weeks at sea, sailors have busied their idle times in many ways. Fortunately — or unfortunately, depending upon one's view — now that all sailors can read and with the advent of paperback books, radio, tape recorded music and other modern diversions, fewer sailors "make things". In addition, most ships today make relatively short voyages between ports.

On our research vessels, however, we make longer voyages so that many hobbies and crafts continue to be popular. Some people carve wood, others build boats and skiffs, some paint, refinish antique furniture, build shipmodels or make fancy knotwork. One outstanding example of craftsmanship is the work by Mr. B. McLauglin, chief engineer of the R.V. 'Chain'. The "Chief" has taken up the old art of scrimshaw.

Mr. Webster notwithstanding, "scrimshaw" denotes only the art and the products or items carved from or engraved into whale teeth and bone, including objects such as boxes inlaid with whale ivory. Beautiful examples of the work done by New England whalers are preserved in musea* and in private collections. Original work has become so scarce that scrimshaw demands high prices at sales.

Although many books and experts call scrimshaw an indigenous American folk art, I agree with the historian Edouard A. Stackpole that "scrimshaw is simply a seafaring development of the ancient art of ivory carving". Examples of scrimshaw made early in the 17th century (before the advent of American whaling) can be seen in the former whaling village de Ryp in North Holland and at Hull in England. Nevertheless, it was the New England whalemen who brought the art to a height unequalled in quality, originality and quantity.

Whaling background

Mr. McLaughlin's interest in the old art form came about rather naturally. His family came from Edgartown on Martha's Vineyard and his great grandfather was one of the many whalemen hailing from that fortunate island. Though some of us who have visited the Azores* on our ships have dabbled at scrimshaw, Mr. McLaughlin started in earnest in 1964 when the 'Chain', on her way back from the Indian Ocean, was tied up at Beirut. Also in port was a Russian whale factory ship. During a visit to the Russian ship, the "Chief" was invited to dip into a barrelful of spermwhale teeth.

True to tradition, Mr. McLaughlin, works the teeth entirely by hand, using a three-cornered scraper for the first scraping of the rough surface and then increasingly fine sandpaper. He only smoothes the part of the tooth on which he will engrave. A hard alloy tool bit is used for the deep lines while the traditional sail needle—with the end stoned round—is used for the fine lines. He once looked

*"Scrimshaw at Mystic Seaport" by Edouard A. Stackpole, The Marine Historical Association, Inc., Mystic Connecticut. Publication 33, March 1958. Many of the fine pieces in the collection of the New Bedford (Mass.) Whaling Museum are used as illustrations in "Songs the Whalemen Sang" by Gale Huntington, Barre Publishers, Mass. 1964.

*Where sperm whaling still is carried out almost exactly as it was done more than 100 years ago.

around the ship for ink but finally decided on burnt sienna and umber which he used for several years to give the work an "old look". More recently he has used commercially available brown and sepia inks. The workmanship is proper. The work is also done on board ship which makes it genuine scrimshaw as opposed to some work, widely available in shops, which is "manufactured" with power tools in land-based shops. Often, particularly in the case of small articles such as earrings, the latter are made of elephant ivory and not whale bone.

Mr. McLaughlin does not produce his work commercially but for his own pleasure and to the advancement of the Institution's "good will". One of his first works went to the 'Calypso' in Monaco. Another tooth has been donated to be auctioned for a charity, while Vice-President Humphrey received one tooth made especially to commemorate his visit to Woods Hole last summer. Two other teeth will be presented to the Marine Laboratory at Plymouth and to the National Institute of Oceanography during the forthcoming visit of the 'Chain' to British ports.

Naturally, the "Chief's" artistic talent did not start with scrimshaw. He has worked with watercolors and charcoal, on eggshell paper and, while on board ship in the Arctic, has built large shipmodels to exact scale.

Good will

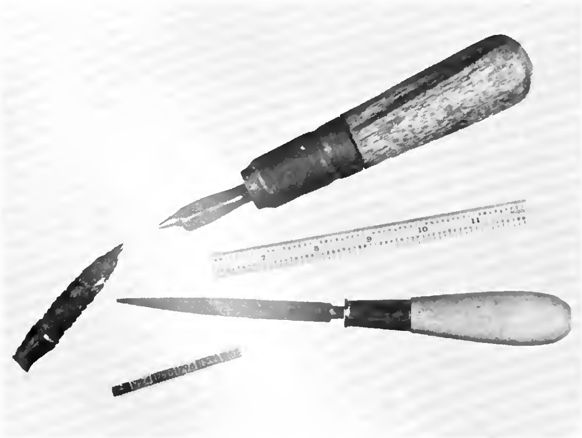
Mr. McLaughlin's work has not been confined to engine rooms and art. While stationed in Labrador, he built a geiger counter and went prospecting in the hills and on Baffin Island. "Once, the counter went wild and I reported the finding but do not know if they ever found anything" he stated.

It appears that there are more scrimshawers on our ships than we expected. By the deadline for this article, scrimshaw was beginning to pile up around us. Undoubtedly we have missed some but fine work has been made by A. S. Wing, M. Palmieri, B. Bailey and particularly by K. Costa, engineer on the 'Alvin's' tender.

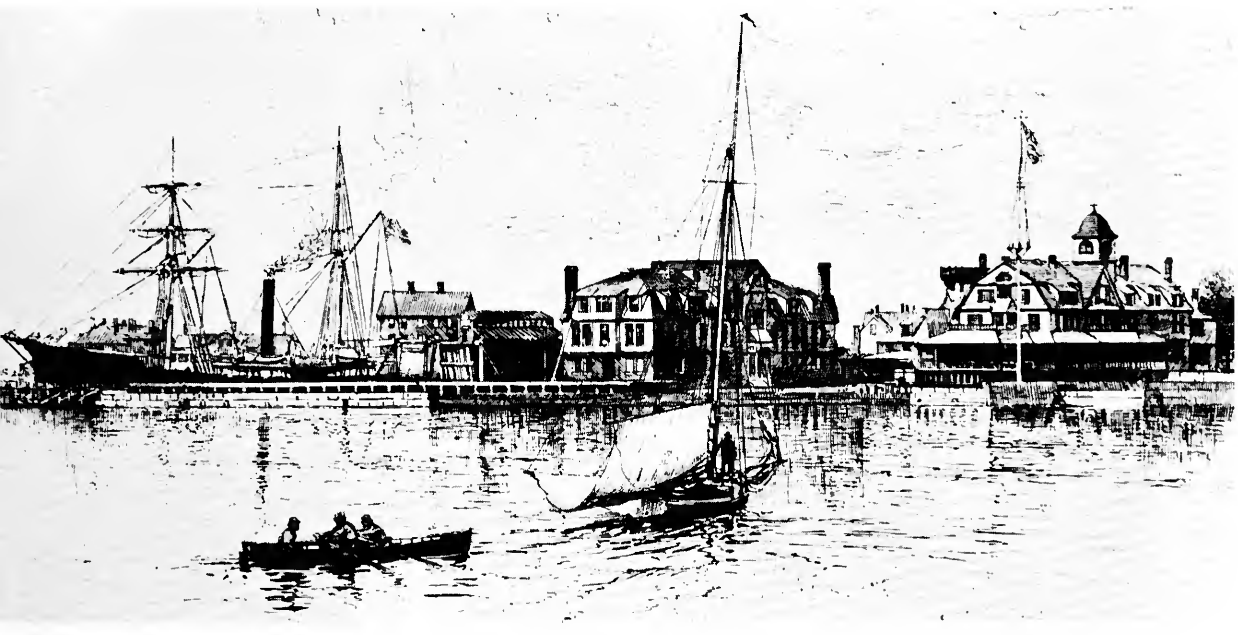
At work in his cabin on board the 'Chain', the Chief works on a sperm whale tooth clamped in a vise.

MEDEIROS

His simple tools consist of a 3-cornered scraper, a heavy scriber, a sail needle encased in electrician's tape and some finely divided rulers.



One of Mr. McLaughlin's best examples is this view of old Woods Hole (spelled: 'Wood's Holl' during a few controversial years). From an original illustration in Harper's Weekly, 1886.



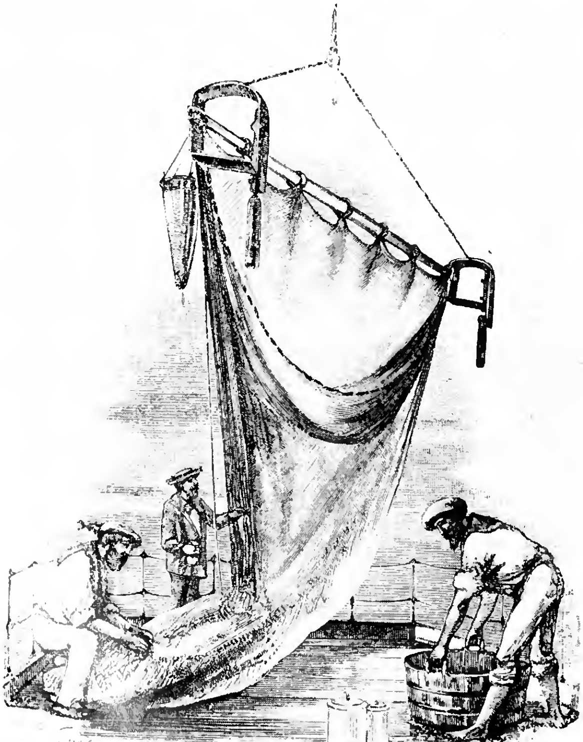
The *Albatross.*

HEADQUARTERS OF THE UNITED STATES FISH COMMISSION, AT WOOD'S HOLL, MASSACHUSETTS.
Photographed by T. W. Smillie

A variety of scrimshaw made on our ships. At top left, a fine work by Mr. McLaughlin made for the Institution which presented the memento to Vice-President Humphrey. The Chief also copied a drawing from the Challenger Report, to be given to our British friends.

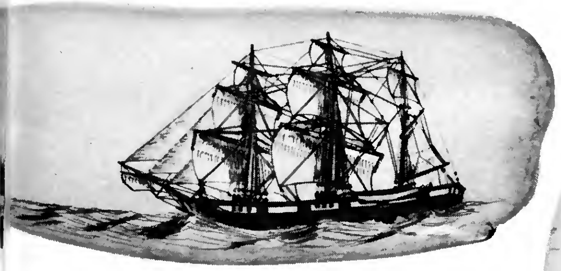
At bottom right, a scrimshawer's dream. Seven sperm whale jaws at a whaling station in the Azores. Only a small part of the teeth appears above the gum.

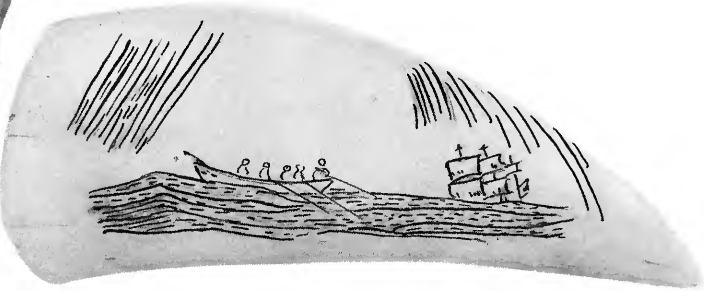
At top right, a beautiful New Bedford whaler made by Mr. K. Costa, engineer on the catamaran tender. The editor's minor contributions are a walking cane, made from a jaw bone with knife and a BT slide, and two primitive works he made on 'Atlantis' cruise A-252.



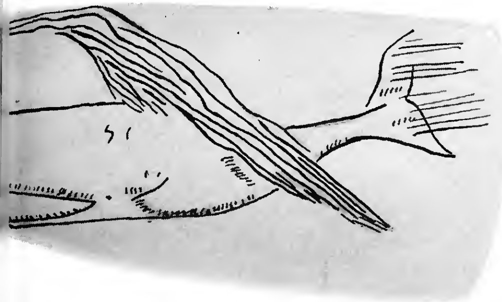
"He visited this country also with a view of catching horse whales, which had bones of great value for their teeth, of which he brought some to the King".

Ochthere (Ohthere)
King Alfred's Orosius—A.D. 890

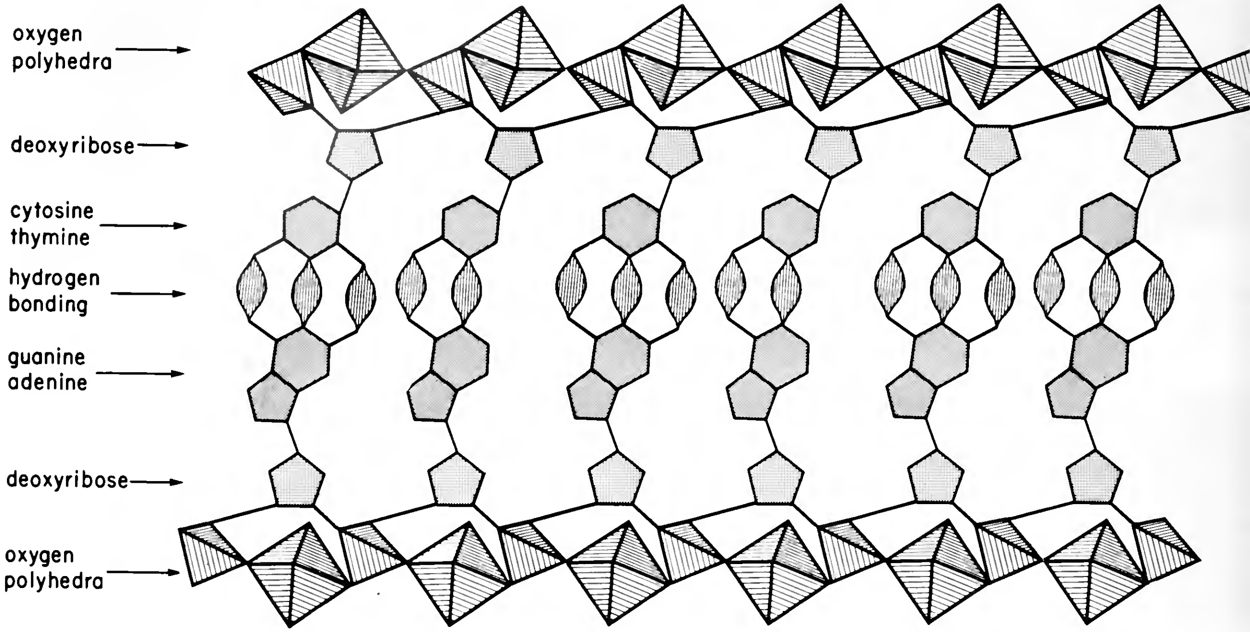




RIMSHAW PHOTOGRAPHS BY F. MEDEIROS
ONE-HALF TO TWO-THIRDS SIZE OF ORIGINALS



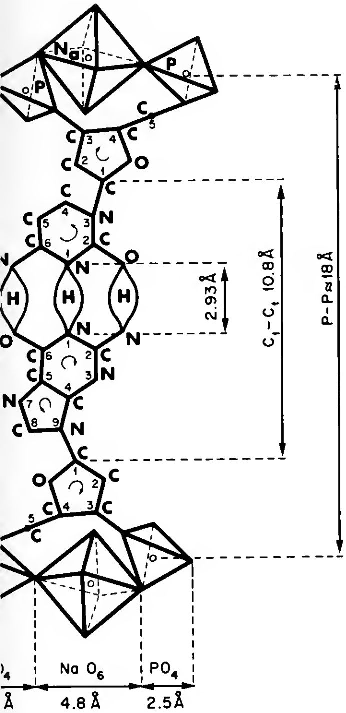
jh



Model of DNA (schematic) showing metal co-ordinated phosphate groups. A sodium ion serves as linkage element between two phosphate tetrahedra by establishing an oxygen polyhedron.

A Graphic Challenge

The minute chemical factory contained in each cell of living tissue is extremely complex. Nevertheless, great progress in the understanding of living matter has been made, particularly during the last twenty years. The advances in knowledge often occurred in leaps and bounds which raised great excitement in the scientific world.



by W. R. BARD

IN recent work, two of our staff members, Drs. E. T. Degens and J. H. Matheja compared the structures of common phosphate minerals to the structures of organic molecules containing phosphate. A remarkable structural similarity was found between the inorganic minerals and the organic molecules. This similarity is due to the fact that in both there is an interplay between metal ions and oxygen which will stabilize the structure of these compounds and introduce a higher molecular order. Depending upon the nature of the metal ion and its structural association with oxygen, different geometries may result. For instance, a tetrahedron or octahedron can develop.

Based on these concepts of metal ion-oxygen interactions it became apparent that some biochemical structures, proposed by other authors, had to be revised.

At our Graphic Arts Department we were faced with the problem of drawing structural models according to the specifications given to us by the two scientists, which incorporated the new concepts.

A revised model of the generally accepted structure of DNA, is shown.* Graphically, such a drawing does not create too much of a problem. Yet, the way of shading, the settings of the text, in other words the general composition, must be well balanced.

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*DNA is the molecule of heredity, much in the news recently with the publication of the book: "The Double Helix", by J. D. Watson, Antheneum, 1968.

After this overture everything became more and more complicated, particularly when the investigators compared membrane structures in biological systems with those observed in phosphate minerals. Octahedra and tetrahedra were juggled around and had to be arranged in a unique three-dimensional pattern which had to be made into a drawing. It was of interest to me that not only the arrangements of the various geometric shapes were of importance but also the holes between them which—so the chemists told me—promote the transport of molecules through a membrane. In turn membranes of this kind act as dynamic molecular sieves.

Line pattern

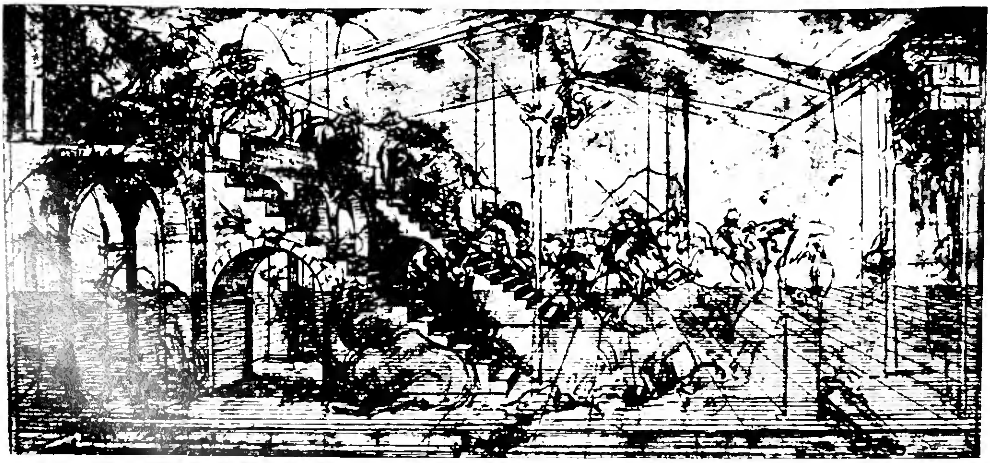
After rejecting the first couple of designs, I realized that depths cannot be achieved simply by using different kinds of commercially available line and dot patterns on the polyhedra surfaces; but in order to show the polyhedra and the undulating surfaces, a three-dimensional impression could be achieved only by means of a distinct line pattern. Two representative examples of such structures are shown, which clearly indicate the way in which the three-dimensional network, composed of phosphate tetrahedra and metal ion polyhedra, is constructed. The undulating and twisting pattern in the figure on page 17 is obtained by slightly reducing the size of the tetrahedra positioned at the lowest level, and by the line pattern on the tetrahedra surfaces which indicates the downward direction. Note that both figures do not encompass graphical distortions or perspective views. This was done purposely in order to reveal the true space dimensions of the molecular structures.

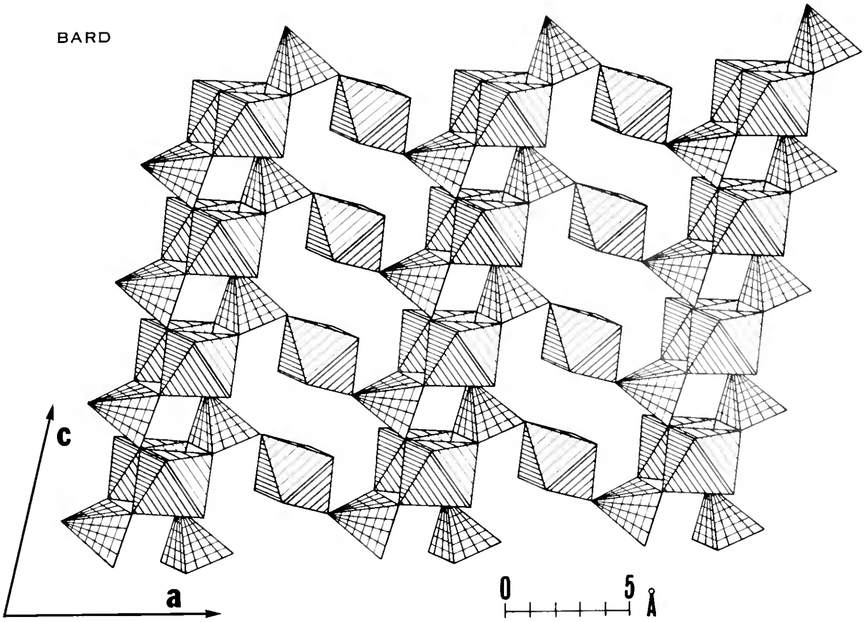
MR. BARD is an illustrator in the Graphic Arts Department of this Institution.

For a better illustration. of the three dimensional arrangement of the various polyhydra, and to reveal the way the holes are incorporated in the structure, a perspective drawing of one of the polyphosphate structures was prepared. This was done by employing the perspective principle which dates back to the Renaissance. The Florentine architect Filippo Brunelleschi rediscovered the mathematical law of perspective, which was known to the Greeks. Artists such as Masaccio, Uccello, Della Francesca, DaVinci, Dürer and others began using the method and within a short period brought about a new approach to drawing and painting giving the illusion of three-dimensional depth on a two-dimensional surface.

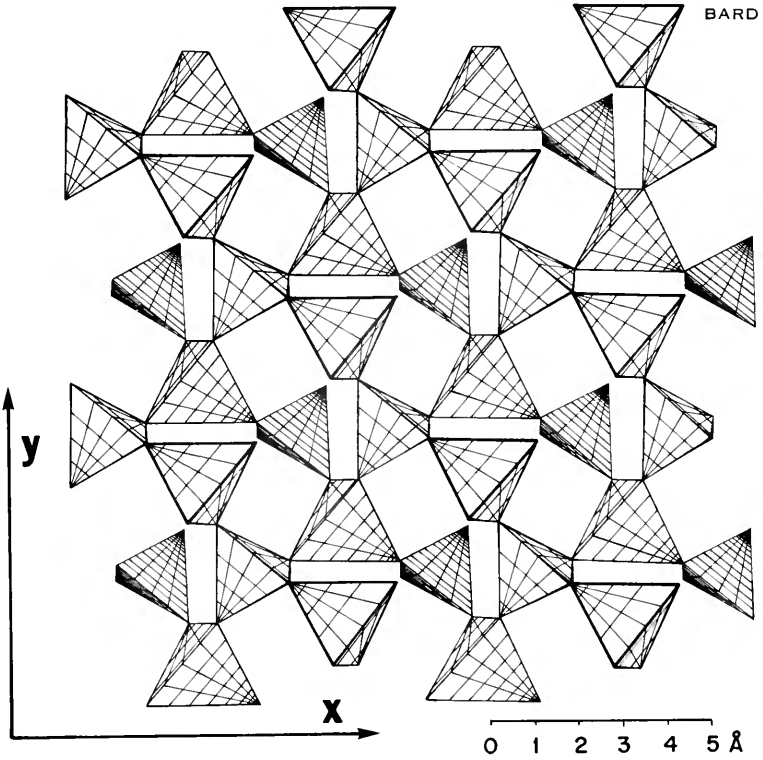
After having drawn so many of these "psychedelic" structures, I feel relaxed. Perhaps another "feature" arranged by the same two gentlemen will lift me into higher dimensions and may involve construction of molecular drawings of brain and nerve cells. These type of drawings are a challenge and certainly not a daily routine.

Three-dimensional study for the background of the Adoration of the Kings, C. 1481, Florence, Uffizi.

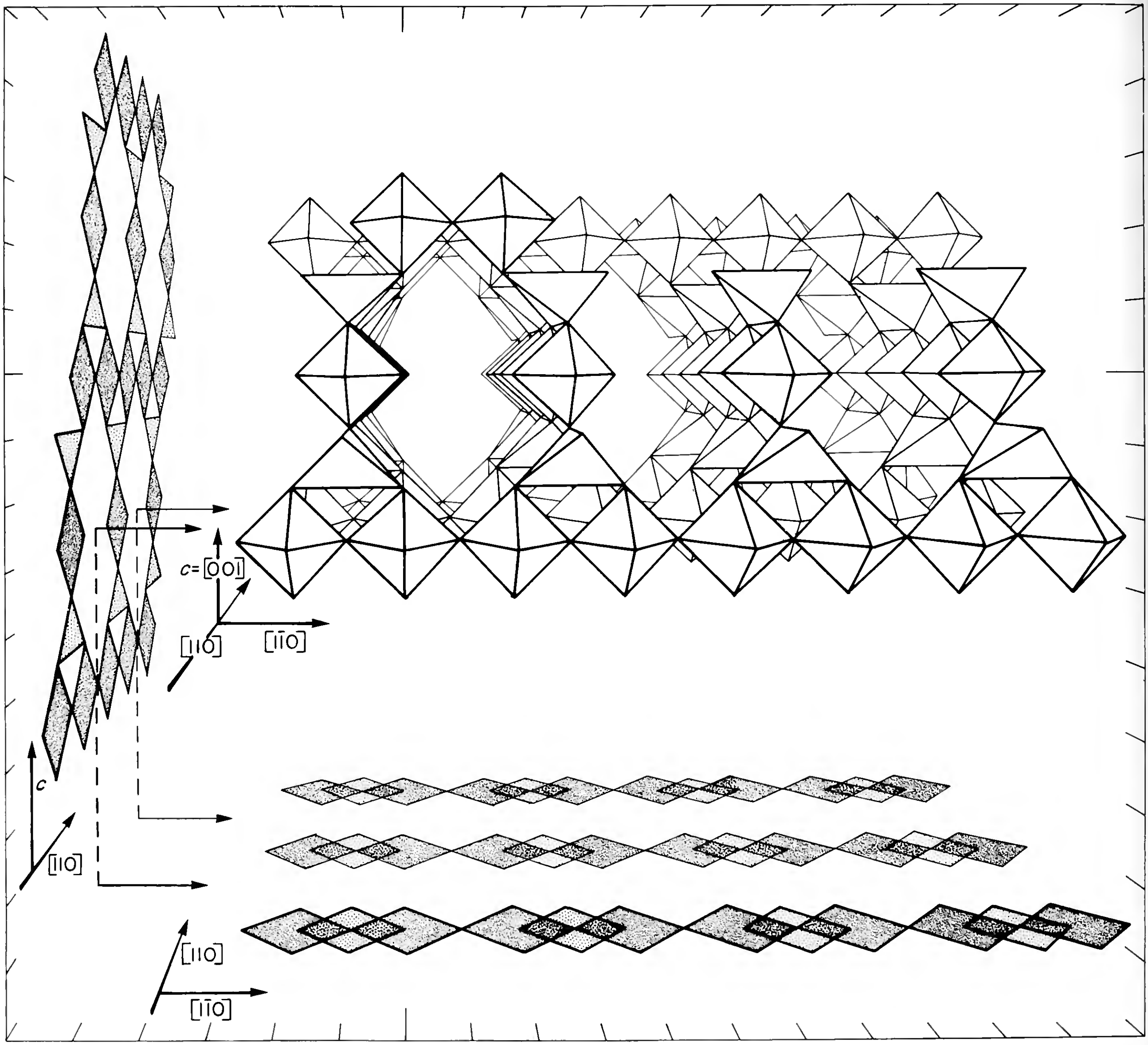




The undulating and twisting pattern was obtained by slightly reducing the size of the tetrahedra positioned at the lowest level and by line patterns on the tetrahedra surfaces to indicate the downward direction. This is the molecular structure of vivianite, built up of single and double octahedral groups of oxygen and H_2O around iron.



The true space dimensions of the molecular structures are shown on both these illustrations. In this figure of Gallium phosphate, each tetrahedron is joined by four additional tetrahedra, forming a three-dimensional network.



BARD

Using the perspective principle dating back to the Renaissance, this drawing includes two projections, one vertically and one horizontally of the main figure.

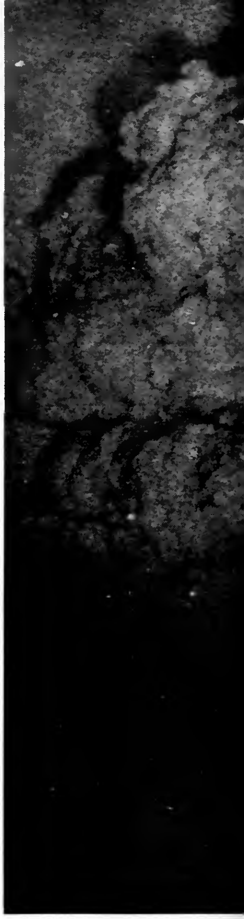
Showing the molecular structure of fluellite, the aluminum atoms are positioned at the centers of symmetry and are bonded octahedrally to two pairs of oxygen atoms, and one pair of fluoride ions.

A NEW MAP

A new map (I-475) has been issued by the U.S. Geological Survey as a part of the continuing program between the Woods Hole Oceanographic Institution and the Geological Survey. This is a "map showing relation of land and submarine topography De Soto Canyon to Great Bahama Bank", and like the earlier publication (I-45, 3 sheets) for the Atlantic continental margin, was compiled and contoured by Dr. E. Uchupi, Associate Scientist on our staff. The chart is a superb contribution to the bathymetry of the area, and serves to emphasize the ruggedness of the submarine topography —such as the Florida Escarpment—when compared with the rather flat adjacent land area.

The scale of the chart is 1/1,000,000. It was compiled from U.S.C.&G.S. smooth sheets, hydrographic surveys, and Army map service sheets. The same format has been used as in earlier charts, and increasing depth (height) is shown by deepening shades of blue (brown on land). An overlap of the eastern third of the map with sheet 1 of the earlier series provides a convenient connecting link between the bathymetry of the Caribbean and Atlantic continental margin. Two additional maps to cover the central and western Caribbean have been compiled by Dr. Uchupi and will be issued soon by the U.S.G.S. This latest map of the eastern Caribbean is available from the Government Printing Office or the U.S. Geological Survey for a cost of $1.00. A smaller scaled map (1/2,000,000) covering the entire Gulf of Mexico is available in a black and white format from Cambie Log Library Inc. of Houston, Texas.

J. Schlee



by F. W. McCOY, JR.

Visual Coring

THE piston corer has become the most widely used device to obtain long samples of bottom sediment. We also hope that these cores will be a true undisturbed sample of the layers of sediment, particularly when an open barreled gravity corer is used as the tripping mechanism. Because of the depths at which coring stations generally are conducted, the operation necessarily has been a "blind" one.

Recently, it has become increasingly important to be able to see both the corer in the process of taking a sample as well as the surrounding bottom conditions. For example, paleomagnetic techniques for dating sediments require a knowldege of the magnetic orientation of the piston corer in the bottom. Recent work at the Lamont Geological Observatory has pointed out the possible significance of bottom currents in transporting sediments, so that it is of great value to be able to detect possible bottom currents near the sample. Although others have tried, the actual operation of a piston corer on the bottom has not been observed, except for a few instances where divers were able to watch shallow water coring operations.

To satisfy these new requirements of coring a new corehead for a piston corer was designed by R.P. Von Herzen, P. Boutin, R. L. Chase, F. Wooding and D. M. Owen. This design incorporated within the corehead two cameras and a strobe light source, modifying an earlier design reported by Ewing, Hayes and Thorndike.* Five cylindrical cavities were

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*"Corehead camera for measurement of current and core orientation". *Deep Sea Research,* 14, 1967.

A cloud of sediment rises as a piston core is photographed hitting the ocean bottom. A new method has made it possible to "view" how the instrument operates in the dark depths. A compass indicates the magnetic direction in which the core was taken and an inclinometer shows the vertical direction in which the corer penetrates.

formed within the head to hold the camera equipment, as well as an instrument to measure heat flow and other desired instruments. For determining the core orientation and inclination, a compass and inclinometer were mounted on a special bracket which was attached to an upper core barrel made of non-magnetic steel five feet (1.6 m) below the corehead. The cameras used were slightly modified EG&G deep-sea cameras, loaded with 50 foot reels of 35 mm black and white film. To allow for both deep and shallow penetrations of the corer into the bottom one of the cameras was focused at 16 feet (4.9 m) and the other at 6 feet (1.8 m). The camera set at a distance of 6 feet was also focused on the compass and inclinometer. The flash interval of the strobe light was modified to give an exposure every five seconds to provide a sequence of action. As the core penetrated the bottom and stirred up the sediment the sequence showed the progressive change in the shape of the sediment cloud by bottom currents. The photos also make it possible to study the actual coring process. A timer on the camera rig was set, just before each lowering. When the rig was near the bottom, we waited, if necessary, to make sure that the camera and light source were triggered by the timer, just prior to the tripping of the piston corer.

Successful use

The new rig was used successfully on 'Chain' cruise 75, in the Caribbean, in the equatorial Atlantic from Barbados to the Mid-Atlantic Ridge, and in the Barracuda Rise area. Bottom photographs were obtained on 25 out of 36 coring stations. Usually, three core barrels were used, each 10 feet long (3.3 m) with a

3.5 inch (9 cm) outside diameter. When fully loaded with instruments, the entire rig weighed about 2400 lbs. (1090 kg) in the air.

During penetration of the corer into the bottom, generally accomplished in five to ten seconds, a symmetrical, dough-nut-shaped cloud was produced around the core barrel. In some cases the velocity of this cloud was high enough to erode small channels into the surface sediment near the barrel. Bottom currents showed up frequently as distinct narrow sediment clouds streaming away from the core barrel. Bottom conditions varied considerable. In a soft muddy bottom, the piston corer would penetrate up to the corehead, burying the cameras into the mud. In a more resistant bottom sediment, the corer would not go all the way in, and bend over. What appears to be a manganese pavement was encountered on station 33. Here, the corer fell on its side and was dragged along the bottom. On station 16, the piston corer rotated as it penetrated, smashing into the pilot corer and breaking the compass.

Other views

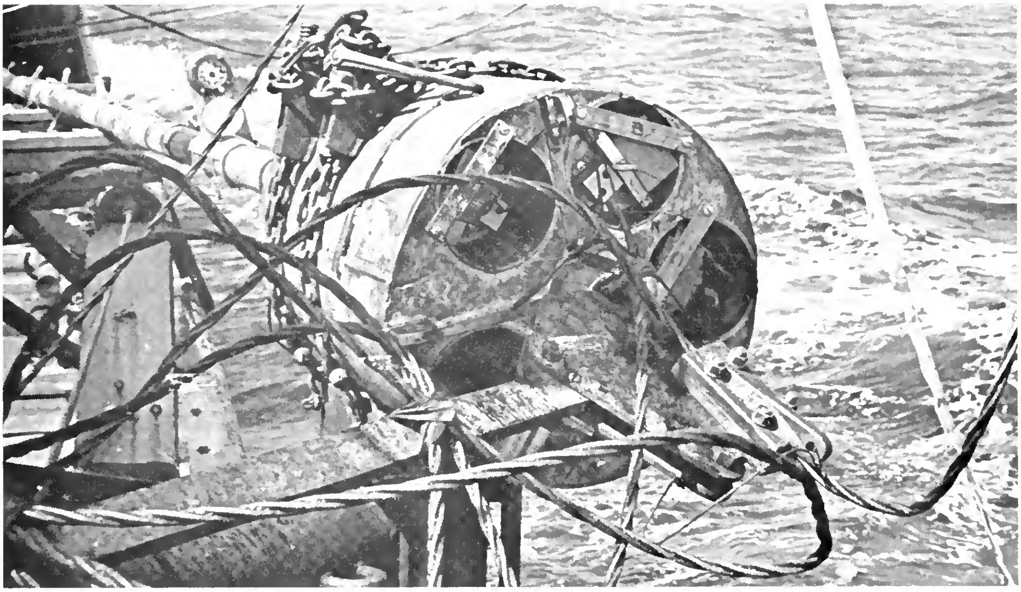
Since the film took approximately 20 minutes to run through each camera, photographs were also taken of the corer while it was being lowered and being brought up after withdrawal from the bottom. These photos indicated that the coring rig is quite stable while going down before it is tripped, but rotates and swings while coming up. On a few stations, the corer rotated considerably as it penetrated and as it was withdrawn from the bottom.

More than 19,000 photographs were taken with the corehead camera on 'Chain' cruise 75. The photos are being studied to determine core orientation and inclinations, bottom currents, core shortening, and to yield information on the coring process.

MR. McCOY is a Research Assistant on our staff. His interest is in deep sea sedimentation.

On station No. 33 the piston corer fell on its side and was dragged along the bottom after hitting what appears to be a manganese pavement.

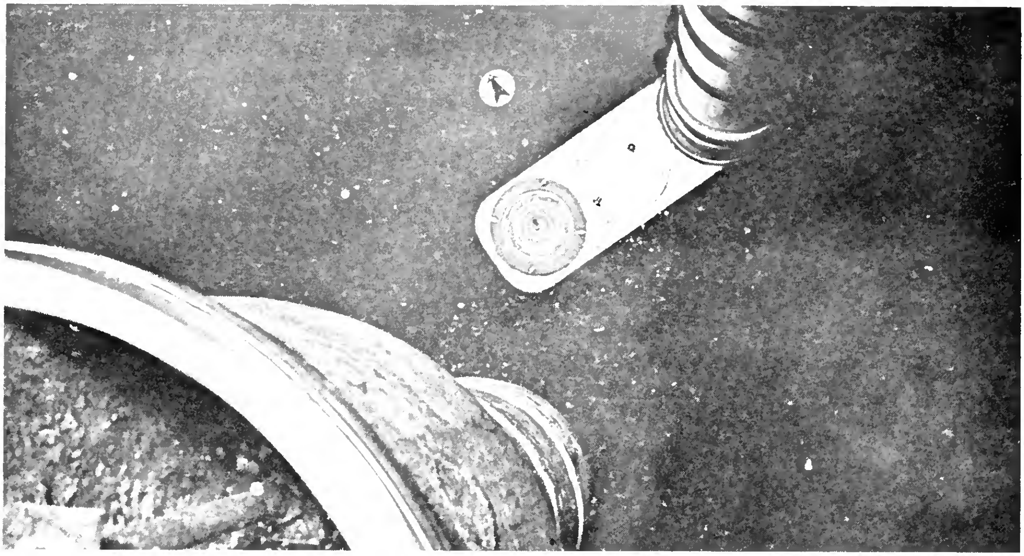
For another photographic application in bottom studies see also: "Combination camera and bottom grab" by K. O. Emery and A. S. Merrill, Oceanus, Vol. X, No. 4, June 1964.



Five cylindrical cavities in the piston corer head contain the camera equipment, an instrument to measure heat flow in the sediment and other instruments, as desired. The compass and inclinometer are shown attached to the coring tube below the head.

In a soft bottom, the camera sometimes was buried into the mud. At left, the bracket holding the compass and the inclinometer has disappeared into the sediment. A mud flow channel appears on the right of the photograph.

In more resistant bottom sediment the piston core may not go all the way in and bend over.



Clearly illustrating what formerly, at best, could be surmised only, this photograph shows that the piston corer rotated as it penetrated the bottom and smashed into the pilot corer at left. The compass broke and its needle rested on the bottom.

It was pretty cold on the deck of the R.V. 'Chain' when the author checked the camera focus at six feet.

Ocean bottom currents showed up frequently, as distinct narrow clouds streamed away from the core barrel.

H. B. Bigelow issue

Among our readers must be some who knew Dr. Bigelow and who may not have been contacted by the editor. We shall be pleased to receive short accounts and/or photographs relating to his many-faceted life.

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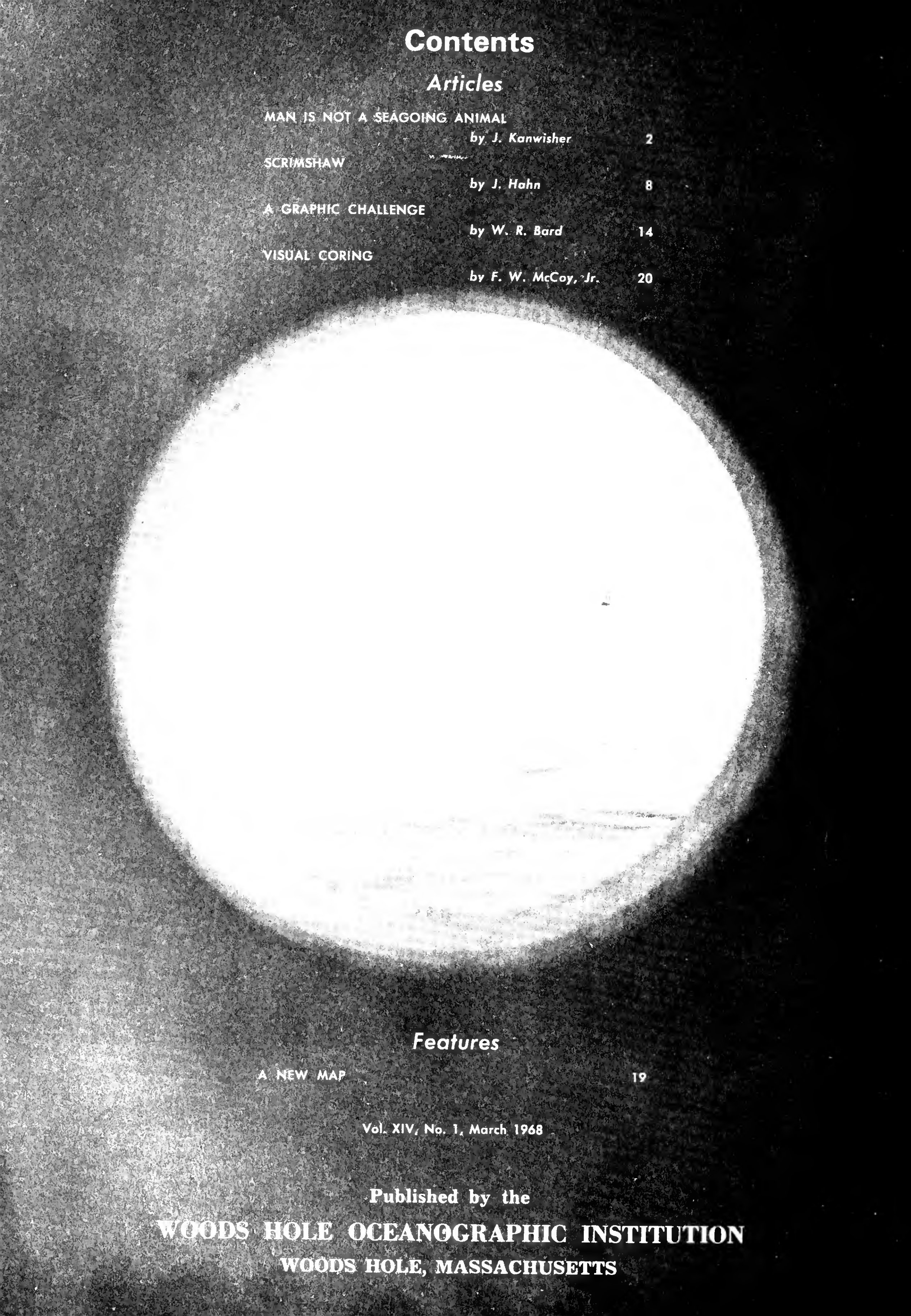

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Vol. XIV, No. 1, March 1968

Published by the
WOODS HOLE OCEANOGRAPHIC INSTITUTION
WOODS HOLE, MASSACHUSETTS