OCEANOGRAPHY

Food Locked Up Forever

Atlantic Ocean Alone Has Stored Away From Plants and Animals 20,000 Times the World's Annual Wheat Crop

By DR. FRANK THONE

WILL Old Ocean swallow all the food?

Is Father Neptune a miserly hoarder, locking up in his vast cupboard a gradually accumulating pile of potential meat and bread, so fixed that neither man nor beast nor fish nor plant can ever make use of it?

Will the sea, which many believe to be the original cradle of all life, eventually become the grave of all life?

Questions pointing in this direction are asked by August Krogh of Copenhagen, a noted physiologist who also has an interest in matters pertaining to the sea, as is proper in a descendant of Vikings. Dr. Krogh has cast his questions in physiological form, inquiring how much energy that can be used for the purpose of life is to be found in the ocean, and how large a fraction of that total is "unavailable"—locked up in such forms that living things cannot get hold of it.

The figures for the "lost" food in the ocean which Dr. Krogh has reached through experiment and calculation are astonishing, and may well be alarming. The Atlantic Ocean alone, he estimates, has the equivalent of 20,000 times the whole world's annual wheat crop locked up in dissolved foods which no known plant or animal life in the sea can make use of.

No Difference With Depth

The method by which this astonishing total was reached shows an interesting combination of experimental ingenuity and sweeping imagination in the mind of the Danish scientist. First he analyzed samples of sea water from the Atlantic, until he found that their chemical makeup was very nearly uniform, no matter at what depth they were taken. That simplified matters considerably: he did not have to allow for depth changes in his later calculations.

Then he determined, by quite difficult chemical processes, how much nitrogen, or protein material, there was in a cubic meter of it. The total protein-stuff in a cubic meter figured out, Dr. Krogh next subtracted all of it that was represented by animals and plants that could be strained out, ranging in size from microscopic one-celled creatures to good-sized fishes. He allowed also for such monsters as whales and sharks that are not found in any given average cubic meter of sea water. The difference between the total protein material and the "organized" protein in the organisms represented the life-stuff actually dissolved in the water, and, for the time being at least, not in use by anything or anybody. This figured out as 1.5 grams (about 1/20 of an ounce) to a cubic meter.

Very Thin Soup

By a similar process, Dr. Krogh determined that the average amount of carbohydrate in ocean water is 3.9 grams (about 2/15 of an ounce) to a cubic meter. If we figure protein as meat and carbohydrate as potato—really a pretty close representation of their chemical nature, at that—it becomes pretty obvious why the dissolved foods in the sea water are not being used. One-twentieth of an ounce of meat and two-fifteenths of an ounce of potato in over a cubic yard of water make a mighty thin soup. Not much nourishment in it for anybody, even a germ.

But there is a most appalling quantity of that thin soup. The Atlantic Ocean alone has an area of about 90,000,000 square kilometers, or 35,000,000 square miles. Its mean depth is 4,000 meters, or roughly 13,000 feet. Put that through your calculating machine, and you come out with something like a quadrillion cubic meters. All that cold salt water holding dissolved, in each cubic meter, a nibble of meat, a small bite of potato! Not remarkable, then, that the old Atlantic has locked up in its meager cupboard the food-equivalent of 20,000 world wheat harvests! If you like to juggle with endless strings of ciphers, you might try adding in the much bigger Pacific and the rest of the oceans.

Is all this dissolved food actually useless? Isn't there anything, any class of animals in the whole vast ocean, that can get some good out of it? The very notion of 20,000 wasted wheat harvests runs against the streak o' Scotch that is in even the least thrifty of us.

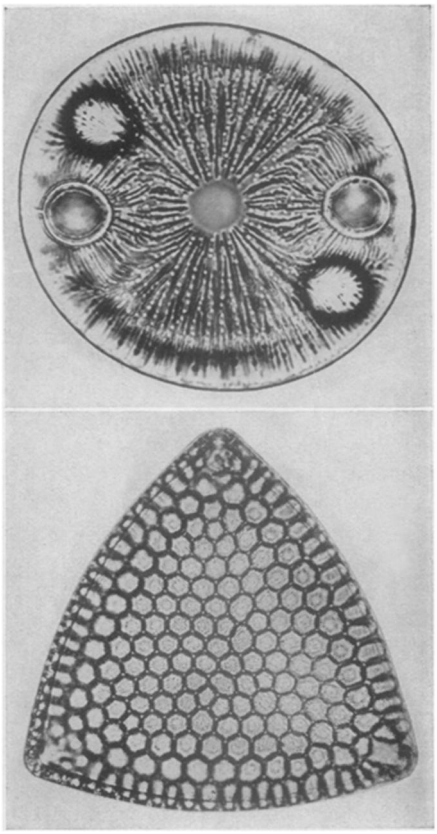
It doesn't look as though there were. Other scientists besides Dr. Krogh have puzzled their heads over that problem of the apparent awful waste of the ocean, and some of them have suggested various types of animal life—protozoa, sponges, even fishes—as able to soak up their nourishment directly out of the dissolved foodstuffs.

Can't Eat Enough

Dr. Krogh will not commit himself dogmatically to a declaration that they can't. But he remains skeptical. Some experiments of his own have indicated that certain forms of water life can take up dissolved foods directly from the water; but they also threw in a joker; the same animals lost food materials to the water faster than they took food out.

The main difficulty seems to be in the extreme thinness of the soup on which such hypothetical direct-absorbing creatures would have to nourish themselves, and that, in turn, becomes a question of the absorbing surface they can present. We ourselves, and the animals physiologically most like us, have a relativity limited area for absorbing food; the lining of the thirty-odd feet of our digestive tract. Down at the other end of the ladder of life, among the one-celled animals and plants, the absorbing area is much greater in ratio to the total body bulk, simply because of the smaller size. They absorb things, most of them, with the whole outside surface of their body, and the less the diameter, the greater the relative surface area.

You can demonstrate this seeming paradox in a very simple way. Cut a cube of potato, or cheese, or putty, an inch on a side. Total exterior surface, six square inches. Cut it in two: you have added two square inches of outer surface, without changing the original cubic inch of bulk. Split each of the halves: you have added four more square inches of surface, and the bulk still remains one cubic inch. The finer you cut the pieces, the faster their total



MAKE SEA GREEN

Here are two greatly magnified diatoms, the most numerous drifting plants of the sea. Where they become abundant they color the sea green. About 8,000 species have been discovered. Dr. Albert Mann of Carnegie Institution of Washington, who has studied these plants for many years, says that in variety and grace of form they surpass all other organisms and that hardly a known shape that combines grace of outline and symmetry of parts appears to be unrepresented by some diatom.

surface grows. If you could carry your sectioning down to germ-sized pieces, the total area of outer surface would be many square yards.

So one-celled organisms would seem to be the most hopeful candidates for the eating of the ocean's overthin soup. But even they decline, apparently. The one-celled animals seem to feed on nothing but the tiny plant life that swarms at the surface and in the upper layers where sunlight penetrates. Bacteria have been suggested. But the ocean seems to be almost barren of bacteria, and the ones that have been found are most numerous near the surface and in the neighborhood of the larger plants which yield a higher concentration of foodstuffs.

No; so far as there is any present positive evidence, nobody wants the ocean's thin soup. The 20,000 wheat harvests must continue to lie in the cold kettle of the Atlantic, and no one knows how much more in the other oceans, for sheer want of a taker.

What is the source of this vast store of "lost" food? Where does it come from—how is it made?

Shallow Waters Favored

For the most part it is made in the ocean itself, and by inhabitants of the ocean. It is the product of minute plants that float in the sunlit water near the surface; for the most part the group of plants known as diatoms, "the grass of the sea." Where conditions are favorable for their growth they multiply rapidly and the water is thick with them, so that the sea is green. Blue, the natural color of sea water, betokens few diatoms, an empty sea, a desert sea. And a great part of any ocean looks back at the sky with this beautiful but empty blue.

In reckoning the life of the ocean, one should leave out of account the inshore waters and the shallow seas. These properly belong to the continents: they receive special gifts of minerals and organic débris from the rivers that flow into them, and they also offer foothold for bottom-anchored seaweed and various forms of animal life, so that shallow waters are always swarmingly alive.

But the open ocean is not thus dependent on the crusts that fall from the table of the land. Except for the mineral gifts from the land, via rivers, blown dust, and showers of ash from volanic eruptions, the open ocean needs to thank the land for little. Its inhabitants make their own lives.

As deep into the ocean as sunlight can penetrate, plants live. Like land plants, the minute plants of the ocean, the diatoms, cannot live without light. With the aid of light, they, like land plants, take carbon dioxide and water and fashion them into food: carbohydrates first, the energy foods, then with the addition of nitrogen the proteins, the muscle foods. This food-making activity of plants is basic, indispensable, in the cycle of life whether on land or in the ocean; for animals cannot make their own foods but must eat plants, or other animals that have first eaten the plants, in order to live.

This plant life in the ocean swarms thickest near the surface. Usually the greatest numbers of diatoms are right at the surface, where the sunlight is strongest, but sometimes in the tropics the greatest density of plant life will be at a little depth. Possibly this is because there the sunlight is a bit too strong; but nobody really knows the answer to that one yet. Anyway, the top 600 feet or so of the water contains practically all the plant life of the ocean, and the next 600 feet below that contains all the rest. Below about 1200 feet no sunlight penetrates, hence no plant can live and make food.

It is interesting to note that practically all the plant life of the open ocean is one-celled, microscopic. Nothing anywhere near as big as a tree, practically nothing as big as a clump of grass. Why?

There are several answers, probably all of them figuring to some extent in the complete answer. First, the ceaseless motion of the waves and currents would not permit the growth of large plants; they would tear them to pieces, as they often do tear to pieces the large seaweeds that grow near shore. Then there is that absorption-surface advantage that goes with small size. The mineral nutrients that all plants need, phosphates, nitrates, potash and the rest, are in much weaker concentration in the ocean than they are in the soil on land, so that big absorbing surface relative to total is necessary. The little fellow can live best on a thin diet.

Advantage of Smallness

Another advantage that small size gives the diatom, in Dr. Krogh's opinion, is that it slows down their rate of sinking. These tiny plants have no aids to flotation that we know about. As soon as they come into existence they begin to sink. But since they are so small the water offers more resistance to their sinking, and they can stay in the all-necessary sunlight near the surface long enough to carry on their part in the food-making cycle.

All these tiny plants are fed upon by all manner of almost equally tiny animals, both while they are at the surface and while they slowly sink down toward the everlasting dark in the abysses. Most of these animals are one-celled like themselves—they are the protozoa. But there are also swarms of others, some of them barely visible to the naked eye, some still microscopic, that are more complex. Many of these are minute relatives of crabs and lobsters. These feed alike on the plants and on the protozoa, and in their turn become the prey of larger animals of their own kind or of small fishes. Larger fishes eat them, and are themselves eaten by still larger ones, or by

the giant squid that the sperm whales feed upon. It is an endless cycle of eating and being eaten.

Dr. Krogh points out that this necessary "stepping up" of the food cycle in the ocean is much more wasteful than is the corresponding process on land, where any plant-eating animal, even an elephant, can make direct use of the vegetation. But there is no escaping it in the sea, where the basic plants are so small that only tiny animals can find them.

Down through this zone of ceaseless kill-and-be-killed drift the diatoms as they grow older. If they are not eaten, they dissolve. Their life-stuff, their protoplasm, dies and filters out through their hard silica shells, their stored food-reserve of oil is dissipated, at last even the silica shells dissolve in the all-claiming sea. The dead diatom has contributed its bit to the ocean's vast kettle of inedibly thin soup.

Science News Letter, December 16, 1933

MEDICINE

Diabetes Increase Not Caused By Greater Sugar Consumption

THE INCREASED diabetes death rate is not due to an increased per capita consumption of sugar, nor to changes in the national diet or living habits, in the opinion of Dr. Charles Bolduan, director of health education, of the New York City Department of Health.

In fact, the increase in the diabetes death rate is more apparent than real, Dr. Bolduan believes. He set forth his views to the American Public Health Association.

Fifty or sixty years ago diabetes was considered a rare disease. Dr. Bolduan has concluded that it was no more rare fifty years ago than it is today, but that fewer cases were detected, chiefly because simple tests for the disease were not available and no routine examinations for diabetes were made.

The disease was once considered more prevalent among men, but Dr. Bolduan believes that this was because routine tests in the course of examination for insurance and for industrial employment were made much more frequently among men than women until recent years. With the increased number of women in industry and also an increased number of women carrying life insurance policies, tests for diabetes are made among many more women now and consequently more cases are being discovered. The result is an apparent increase in number of cases among women, Dr. Bolduan explained.

Much of the increase in deaths recorded from diabetes is fictitious, Dr. Bolduan said, for many of the deaths represent merely the death of a diabetic individual from some other cause. It seems that when a person who has had diabetes dies, the death is officially registered under diabetes. If there were other causes, they were mentioned secondarily, but the result is a swelling of the diabetes death lists.

Diabetes develops most commonly after middle life. The aging of the population, because of a declining birth rate and cessation of immigration, has a marked influence in increasing the prevalence of the disease. Likewise, in New York City the relative increase in the Jewish population has led to an increased prevalence of the disease in the city, because the disease occurs much oftener among Jews than non-Jews, a health department survey showed.

Diabetes is more prevalent than is generally believed. No one knows exactly how many cases there are in the country because it is not reported like communicable diseases such as smallpox, typhoid fever, etc.

As to the increase of diabetes being charged to increased eating of sugar or marked change in the relation between the expenditure of physical energy and food intake, Dr. Bolduan does not see why these factors should affect the death rate of women exclusively. When allowance is made for the aging of the population, the increase is seen to be limited to diabetes deaths in women.

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Germany, homeland of the Pied Piper, is arranging to have extermination of vermin handled by scientists instead of pseudo-professionals who it is claimed do not sufficiently protect the public against accident and deception.

GENERAL SCIENCE

Smithsonian Institution Benefits By Patent

UNSELFISHLY sacrificing his chance for personal profit in the interest of the advancement of science, Dr. Adolph M. Hanson of Faribault, Minn., has assigned to the Smithsonian Institution all income and royalties accruing to him from his process of extracting the active principle of the parathyroid gland, on which he has recently been granted a patent. The announcement of Dr. Hanson's benefaction to the Smithsonian Institution is made by Dr. Oliver Kamm in *Science*.

Dr. Hanson conducted the research leading to his discovery in the few spare moments allowed him by an active medical practice. He completed the work several years ago, but litigation to clear up conflicting claims has delayed the issue of the patent until quite recently. The parathyroid principle, which has important uses in medicine, is now being manufactured according to the Hanson process by three large pharmaceutical firms.

Dr. Hanson's benefaction is to be known as the Martin Gustav and Caroline Runice Hanson Fund.

Science News Letter, December 16, 1933

PHYSIOLOGY

Doctors Report Progress With Weight-Reducing Drug

ENCOURAGING results with the new weight-reducing drug which enables fat persons to lose weight while eating an ordinary diet have been obtained by Prof. E. C. Dodds of the Courtauld Institute and Dr. J. D. Robertson of the