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OCEAN CIRCULATION

THAT water in the Pacific ocean circulates more slowly than it does in the Atlantic, is the conclusion drawn from the amounts of oxygen found in water samples collected by the ill-fated, non-magnetic ship, *Carnegie*, of the Carnegie Institution of Washington.

This discovery was announced at the recent Washington meeting of the American Geophysical Union by J. A. Fleming, acting-director of the Department of Terrestrial Magnetism of the Carnegie Institution.

A gasoline explosion, in the harbor at Apia Samoa, two years ago, caused the complete burning of the *Carnegie*, veteran of many scientific expeditions around the world. Fortunately for the present investigations, complete records and samples of the cruise had just been shipped from Pago-Pago in American Samoa and were in the mails at the time of the disaster.

Analyses of the oxygen content of the sea at different depths were made throughout most of the Pacific ocean. The deep-sea water of the Pacific was found to contain much less oxygen than previous oceanographic observations have shown to be in the deep-water of the Atlantic.

"From this it was concluded," said Mr. Fleming, "that the deep-water of the Pacific has lacked contact with the atmosphere for a longer period than the Atlantic deep-water. This is either because the Pacific water flows at a slower rate or is farther removed from its sinking center."

Oxygen gets into the water in two ways. It is either dissolved from the air or formed during photosynthesis, the process by which marine plants build themselves up with the help of the sun's rays. Four separate layers of water were readily recognized from the oxygen amounts. There is a layer of high oxygen-content near the surface, followed by one containing the maximum quantities where photosynthesis occurs. Below this the oxygen decreases to a minimum at about 700 meters. In the fourth and lowest layer the quantity of oxygen increases slowly with increasing depth but is always considerably less than at the surface. Unusual currents upset the regular sequence of these layers.

Temperature variations and determinations of the amounts of phosphates in the water also showed the existence of local currents.

The work of compiling and interpreting the results obtained by the lost ship is now far advanced but is not yet completed.

WEATHER CYCLES

A WEATHER cycle, first observed by noting the years when good and bad wines were made, will tell the flow of the Colorado River during the next ten or twenty years, according to A. F. Gorton, of the Scripps Institution of Oceanography, La Jolla, California, speaking before the American Geophysical Union.

For huge water-storage projects like the Boulder Dam it is becoming increasingly necessary to be able to forecast far in advance, and this, said Mr. Gorton, is promised by the cycle theory of weather. The Brueckner cycle of 22 years has been detected in recent years in records of rainfall, river flow and lake levels, in spite of the fragmentary and inaccurate data available.

Several thousand years of climate history have now been written from observations of eccentricities of the weather before the thermometer and rain gauge were introduced. Floods, droughts, severe winters, prolonged freezing of harbors, rivers, lakes and seas and the devastation of hot, dry summers have been noted by people throughout history. From this dramatic if slender narrative the essential correctness of Brueckner's 22-year period has been demonstrated successfully.

"Coupled with this history of recurring anomalies of the weather," said Mr. Gorton, "we have vague but persistent evidence of a gradual drying-up or desiccation of climate in certain regions, such as Mongolia, Tibet, Iraq, Northern Africa, Peru, Mexico and, in our own country, New Mexico at the site of the cliff dwellers. In most cases the evidence of desiccation is based on lower lake levels.

"It is possible to establish the existence of certain cycles by means of official Weather Bureau records of rainfall and temperature, although in no case are they older than sixty years. Also fairly accurate observations have been made in the older cities of the East since revolutionary times."

Rainfall records from both the east and the west coasts of this country show the Brueckner cycle, though the crests of the curve or years of maximum rain are completely out of step. The floods of the Murray River, in Australia, show the same periodicity, but there is a six-year difference between southern Australia and southern California.

Rainfall and stream flow on the west coast show other regularities, of two to three years, five and one half years, and eleven years. All these cycles are deducible from the periods of fluctuation of sun-spot numbers and are simply related to the longer Brueckner cycle.

From facts of this kind it will be possible to make forecasts of the trend of precipitation up to twenty-five years. The value of such predictions to agricultural, economic and financial interests, not to mention the large utility companies, can hardly be overestimated.

EFFECT OF ULTRA-VIOLET LIGHT ON COMETS

GREAT outbursts of ultra-violet light from the sun may press so hard on the tail of a comet as to break it in two. This is the theory presented before the American Geophysical Union by Dr. H. B. Maris, of the U. S. Naval Research Laboratory.

The curious fact that sunlight can cause such huge pressures as this is at the basis of Dr. Maris's new theory of the irregular variations of brightness observed in comets. During periods when many sun-spots are

visible, the ultra-violet light streaming out from the sun may increase as much as a thousand times.

The atmosphere of a comet is transparent to visible light but strongly absorbs ultra-violet light which, because of this absorption, exerts a pressure on it. The effect on the comet is to create a strong wind in its atmosphere moving away from the sun. Thus that part of a comet that feels the pressure most may get a violent jolt when a new whirlpool appears in the sun.

Magnetic storms, those great fluctuations of the earth's magnetic forces, often accompany or anticipate the unusual changes in comet activity. Since the magnetic effects are known to be due to the ultra-violet surges associated with bright spots on the sun, this forms additional support for the new theory of comet behavior.

Comet activity shows itself by changes in the brightness of the atmosphere of the comet, similar to those observed on the earth during a display of the aurora or northern lights. The aurora is caused by increased ultra-violet light from the sun. It occurs at the same times as the magnetic storms.

Dr. Maris studied records of the great comets of last century. He found that the splitting of a comet was accompanied or preceded in nearly every case by a great magnetic disturbance on the earth. The great comet of 1882 met a tremendous solar disturbance at the time of its approach to the sun. Dr. Maris believes that this was the cause of its subsequent disruption.

THE EFFECT OF MOONLIGHT ON RADIO RECEPTION

MOONLIGHT, like sunlight, interferes with the successful reception of radio, according to the report of Dr. Harlan T. Stetson, of the Perkins Observatory, made to a joint meeting of the American Institute of Electrical Engineers and the New York Electrical Society at the Ohio Wesleyan University.

The strengths of signals between Chicago and Boston for the last few years have been analyzed by Dr. Stetson and found to be received about one hundred per cent. better when the moon was below the horizon. This is believed to be due to a negative electrical charge on the moon.

The unfavorable influence of the moon on the reception of radio waves of 4,000 kilocycles has also been independently established by Lieutenant H. F. Breckel, of the U. S. Navy Department, in Cincinnati. Lieutenant Breckel worked without knowing of the Perkins Observatory experiments.

Radio waves travel long distances only because they are reflected from a layer of electrified particles lying in the upper atmosphere about seventy miles from the earth. This radio mirror, called after its discoverers, the Kennelly-Heaviside layer, is pushed down towards the ground when the moon is passing overhead.

This produces somewhat the same sort of disturbance in radio transmission as that produced by sunlight. "The sun constantly bombards the earth's atmosphere with electrons or bundles of energy of high frequency," said Dr. Stetson. "These in turn tear apart the positive and negative charges of the atmospheric molecules. . . . . If the sun is more active on occasion, as when large spots appear on its surface, the degree of ionization increases, producing substantially the effect of lowering the Kennelly-Heaviside layer and upsetting the radio reception. . . . Recent investigations in the field of correlation of radio reception with astronomical phenomena point now to the radio receiver as a valuable instrument of research in cosmic physics."

The decreased strength of reception at present over that experienced in the early days of broadcasting and the vastly poorer reception in the day time compared with night time are both due to the changing effect of the sun's rays on the earth's atmosphere. In addition, however, both day and night reception vary greatly from time to time for what has often seemed no good reason at all. We have come to believe much of the cause for this varying degree of reception is to be found in the sun's atmosphere itself.

The gigantic cyclones in the sun, which we see as sunspots increasing and decreasing every eleven years, are now found to be the cause of the changes of the electrical state of the atmosphere and thus of the clearness of radio reception.

METALLIC ZINC

A REVOLUTIONARY new process for producing metallic zinc of unusual purity from the concentrated ore, which is expected to find wide application because of its economies, has been developed by the U. S. Bureau of Mines.

In the new process natural gas, which is plentiful in most of the states where zinc is mined, replaces coal that is expensive because it has to be hauled a great distance. The chemical reaction that changes the impure zinc oxide to the metal takes place at a much lower temperature than in the old clay retorts, so that plant maintenance expense is greatly reduced. The new process can also be made continuous whereas the one in practice now is intermittent. Officials of the Bureau of Mines do not say just how much cheaper the new process will be, but it is obvious that a great saving will be effected.

The development was described to zinc miners and engineers at the meeting of the American Zinc Institute, in St. Louis, by R. S. Dean, chief engineer of the Metallurgical Division of the Bureau of Mines. It was devised by Charles G. Maier, metallurgist at the Pacific Experiment Station of the bureau in Berkeley, California.

Mr. Maier first showed by mathematical calculation that pure zinc could be obtained from the ore by methods better than current practice. He then proved in the laboratory that his theoretical reactions were correct. Next, an experimental zinc smelting plant employing the new process was set up in the Rare and Precious Metals Experiment Station at Reno, Nevada, in which the method worked out by theory was tried on a practical scale and found to be successful.

YELLOW FEVER AND AIR TRAVEL

THE possible spread of yellow fever by air travel was discussed at the recent Pan American Conference of directors of health, meeting in Washington.

New discoveries have shown that control of yellow fever is not so certain as it once appeared, and the speed of air travel adds greatly to the hazards which public health officers must fight in keeping down this disease.

The discovery that thirteen varieties of mosquitoes, instead of one, are susceptible to yellow fever and may spread the disease, complicates the situation enormously. It means, among other things, that countries which thought themselves safe because they were fighting the *Aedes aegypti* mosquito are no longer safe. India, for instance, with its teeming millions of uneducated people, has so far been free of the disease. But the mosquitoes capable of transmitting it exist in India, and just one unsuspected or uncontrolled yellow-fever patient might start an epidemic of horrible proportions.

Another disturbing discovery has shown that many people have such light cases of yellow fever that it is not recognized. They may actually become unrecognized carriers of this disease for a short time. A new test, devised by investigators of the Rockefeller Institute, shows whether or not you have had yellow fever. If you have had it, serum from your blood injected into monkeys or white mice will protect these animals from the disease when its causative germ is injected into their bodies. But this test is not quick, and the best method of protection still remains effective quarantine against yellow fever. The health authorities at this conference expect to work out improved methods for such quarantine.

ITEMS

A NEW low in the measurement of extremely small lengths was announced by Professor Arthur H. Compton, at the Washington meeting of the American Physical Society. He has measured the length of waves in the X-rays correct to the five hundredth part of the diameter of a single atom. In inches this length is much lower than we can conceive. It is the hundred thousandth part of the millionth of an inch. The wave-length itself measured by this process was about 700 hundred atom diameters, and was thus known with an accuracy of one part in 300,000. The measurement is made with an instrument known as a double X-ray spectrometer. In a spectrometer the rays fall on a crystal which breaks them up into their constituent vibrations. By noting the angle at which these leave the crystal, the wave-length, that is the distance from crest to crest of the vibrations, can be estimated with extreme accuracy. A double spectrometer, a recent refinement, is even more powerful in searching out these small distances.

THE mile-long tube at Pasadena, California, to be used by Dr. Albert A. Michelson, of the University of Chicago, for his new determination of the velocity of light, has had its length measured to an accuracy of one part in a million. The result was announced to the meeting of the American Geophysical Union by Dr. William Bowie, chief of the division of geodesy of the U. S. Coast and Geodetic Survey. The measurement was made by Mr. Clem L. Garner, assistant chief of the same division. The tube is approximately 1,594 meters in length. The 50-meter tapes used in the measurement were made of invar, a metal which changes its length very little with changes in the temperature. They were standardized at the U. S. Bureau of Standards in Washington. The air will be removed from the tube for the speed measurement. The velocity of light in a vacuum will thus be found directly for the first time on the surface of the earth.

IF astronomers peering through their telescopes see bright clouds of hydrogen on the surface of the sun, they can tell that on the following day the sensitive magnetic needles of their observatories will quiver and move from their true position. This prediction, now possible as the result of a discovery by Dr. G. E. Hale, of the Mount Wilson Observatory, was announced at the meeting of the American Geophysical Union by Dr. Seth B. Nicholson, of the same observatory. Dr. Hale has found that exceptional magnetic storms on the earth occur a little over one day later than the flaring of the hydrogen. He has collected accounts of several extraordinary outbursts of this nature which were followed by exceptional magnetic disturbances on the earth. The hydrogen clouds occur in or near active groups of sun-spots and show rapid changes. The sun-spots themselves are darker than the surrounding surface of the sun.

HOW tree and shrub associations over a countryside may be used to make a rapid survey of the kind of rocks that lie beneath, is told by Dr. Robert H. Cuyler, of the University of Texas, in a report to the American Association of Petroleum Geologists. Dr. Cuyler found, in a study of various geological formations in Texas, that each type of rock formation had a distinctive type of vegetation growing on it. One formation supported woods in which a species of oak predominated, another was covered with a juniper forest, a third was marked by mesquite thickets. Two maps of a selected region, one showing only the vegetation and the other only the rock formations, are found to be divided up into areas that correspond very closely in size and shape. Dr. Cuyler believes that with the use of aircraft it will be possible to make very rapid geological reconnaissances of new territory.

RESIDENTS of Marseilles recently had the experience of actually looking "around the corner" of the earth when they saw Mt. Canigou, 157 miles to the west, silhouetted against the setting sun. Actually, the straight line joining the peak with Marseilles passes almost 400 feet below the surface of the Mediterranean. However, the atmosphere of the earth refracts the rays of light around the curved surface. In February and October the sun sets behind the mountain, as seen from here, and then the effect can be observed.