

SCIENCE NEWS

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HEAVY WATER

JUST how much of the increased weight of "heavy" water is due to heavy-weight hydrogen and how much to heavy-weight oxygen has been shown by Professor Gilbert N. Lewis, of the University of California, in a communication to the *Journal* of the American Chemical Society.

All water molecules are composed of two atoms of hydrogen and one atom of oxygen, H_2O . But there are two kinds of atoms of hydrogen and three kinds of atoms of oxygen. The different atoms of any one element have different weights because their atomic hearts are different. The H may be either hydrogen isotope of mass one or hydrogen isotope of mass two and the two common types of oxygen are isotope of mass 16 and isotope of mass 18. Light water or nearly all pure ordinary water is made up of the lightest hydrogen isotope number one and the lightest oxygen isotope number sixteen.

Heavy water is made up of combinations of the heavy hydrogen and the heavy oxygen with the common lighter constituents. In a given sample of heavy water the amount of increased weight due to the strange hydrogen and the amount due to the heavy oxygen has never been known previously.

Professor Lewis took a sample of water from a still that concentrated heavy water and weighed it. He found that its density was 0.000182 in excess of light water. He saturated it with ammonia when the water was at 0 degrees Centigrade and then pumped off the ammonia when the water was at room temperature. By repeating this process he was able to remove 99 per cent. of the heavy-weight hydrogen. The remaining heavy water now had an excess density of 0.000085 so that the heaviness of the original sample was due to 0.000097 of heavy-weight hydrogen.

He then started again with another sample of the same heavy water and treated it with sulfur dioxide to remove the isotope of oxygen of mass 18. His measurements showed that of the original excess density at least 0.000073 was due to this oxygen.

Adding up the figures for hydrogen and oxygen, Professor Lewis accounted for 0.000170 of the original 0.000182. He states that an improvement of this simple experiment will provide an exact method for the analysis of water containing isotopes of both hydrogen and oxygen.

HEAVY WATER IN STAGNANT SEAS

THE new "heavy" water has been found in detectable quantities in the salt deposits at the bottom of extinct stagnant seas.

Dr. E. B. Washburn, chief chemist of the Bureau of Standards, has announced that the richest natural source of this peculiar type of water is to be found in native borax, a salt that exists in the beds of dead seas. The water of crystallization of this native borax contains seven parts of heavy water in every million parts of ordinary water.

Samples taken from the largest existing bodies of stagnant water, the Dead Sea in Asia Minor and the Great Salt Lake in Utah, when purified showed an increased weight over pure ordinary water. The Dead Sea water was heavier by two parts in a million and the Great Salt Lake sample was three parts in a million in excess of standard light water.

These natural sources of heavy water do not begin to compare in concentration with those prepared in the laboratory by Professor Gilbert N. Lewis, who has succeeded in preparing heavy water that is 35,000 parts per million heavier than ordinary water. Recently he has shown that pure heavy water will prevent the sprouting of tiny tobacco seeds and is determining now whether the seeds subjected to these tests were actually killed or only inhibited.

Dr. Washburn explained the presence of heavy water in stagnant seas as due to the faster evaporation of light water. The strange heavy component lags behind and in the course of thousands of years the remaining water becomes richer and richer in heavy water. The native borax that gave the highest concentration presumably came from a sea that was very old and had very few sources of fresh water.

Heavy water, like all water, has two atoms of hydrogen and one atom of oxygen. But either the hydrogen or the oxygen atoms, or both, in the heavy water have heavier hearts or nuclei than the common hydrogen or oxygen nuclei present in ordinary water. These rare types of hydrogen and oxygen are known as hydrogen isotope of mass two and oxygen isotopes of masses eighteen and seventeen. Part of the increased weight of the heavy water is due to the heavy hydrogen atoms and part is due to the heavy oxygen. The discovery of heavy hydrogen was made only two years ago by Professor H. C. Urey and Dr. G. M. Murphy, of Columbia University, and Dr. F. G. Brickwedde, of the U. S. Bureau of Standards.

PROFESSOR BORN'S RECONCILIATION OF OLD AND NEW PHYSICS

THE reconciliation between the new concepts of physics and the old classical views accomplished by Professor Max Born, of the University of Göttingen, is announced in his letter to the current issue of *Nature*, entitled: "Modified Field Equations with a Finite Radius of the Electron."

The letter reads as follows:

The attempts to combine Maxwell's equations with the quantum theory (Pauli, Heisenberg, Dirac) have not succeeded. One can see that the failure does not lie on the side of the quantum theory, but on the side of the field equations, which do not account for the existence of a radius of the electron (or its finite energy = mass).

I have developed a new method of the quantization of the electromagnetic field in such a way that the four independent variables (time-space) are treated absolutely symmetrically and the principle of relativity is trivially

fulfilled. From very general principles of quantum theory (superposition of states, linearity of the equations for the amplitudes of probability) one can deduce how Maxwell's equations have to be modified. In the classical theory, they are equivalent to the statement that the Lagrangian is given by: L is equal to one half of the quantity H squared minus E squared; in the new theory, this expression is replaced by a linear function of the field components, whose coefficients are non-commutative quantities of a type similar to those in Dirac's theory of the electron. In the limit, where the classical theory should hold, the new Lagrangian does not go over into the above given expression, but into: L is equal to one divided by " a " squared times the square root of the quantity (one plus " a " squared times the quantity H squared minus E squared) where " a " is a constant of the dimensions r sub-zero squared divided by e (e is equal to charge, r sub-zero is equal to radius of the electron), and only in the limit " a " approaching zero does this tend to the expression: one divided by " a " squared plus half the quantity H squared minus E squared.

Professor Born then gives an example of the simplest case of a symmetrical field independent of time and gives the differential equation of that field and the solution of this equation. These equations are omitted in this account of the letter because of the difficulty of translating them into terms other than mathematical nomenclature.

The letter to *Nature* is concluded with the statements:

The form of the general expression for L guarantees the relativistic invariance. Thus there is no difficulty in calculating the properties of a moving electron on the basis of the classical theory. But the importance of the new Lagrangian L seems to lie in the possibility of a systematic quantization of the field.

PHOTOGRAPHIC PRINTS IN COLOR PROCESS

PHOTOGRAPHIC prints in color can now be made with but slightly more trouble than ordinary black and white pictures, according to those who have investigated a new German process, the invention of Dr. Bela Gaspar. Most color photographic processes hitherto have been limited to the production of lantern slides or transparencies which had to be examined in front of a bright light. With the Gasparcolor process, it is claimed, such a transparency, which can be made in a number of ways, can be used as a "negative," a piece of sensitive paper exposed behind it in the usual manner, the paper developed and fixed, and then converted to a color print by immersing in one additional bath. As many prints can be made as desired.

The emulsion of the sensitive paper is in three layers, instead of one, as in the common photographic paper. Each layer is so sensitized that it responds only to a certain group of colors. The top layer is sensitive to the blue, the middle to the yellow and green, and the bottom to the red end of the spectrum. Actually, Dr. Gaspar found that red light was absorbed by the two layers above it, but he overcame this difficulty by making the lower layer sensitive to infra-red rays, which are transmitted through them.

When the color transparency is placed in front of a

sheet of the paper, and the whole exposed to light, each layer of the emulsion picks out part of the color, and then when it is developed each layer forms a record in clumps of silver, which is what makes up the blacks of the ordinary photograph, of the distribution of that particular color. In each layer is also a dye, which is bleached by the action of the silver. This bleaching is accomplished in the third bath, to which the print is subjected after fixing. The result is then a print in which the distribution of color corresponds with that in the transparency, which, in turn, reproduces the original subject with more or less fidelity. It is stated that the method can also be applied to film for making color motion pictures.

Many methods are available for making the transparency. In those like the autochrome or Agfa process, the plate is covered with microscopic colored granules, through which the emulsion is exposed. The part back of each granule is sensitive to that particular color. Instead of making a negative, then a print, the original plate is turned from a negative into a positive, and then the small colored granules make up a colored picture, in a manner similar to the small dots that make up a half-tone picture as reproduced in a newspaper. The Finlay process is similar, but the screen is a separate unit, and is made up of small colored squares, instead of promiscuously placed granules. A plate is exposed behind one of these screens, developed, a print made on another plate, and another screen placed over the print on glass, thus making the picture in full color. Either method, as well as others, can be used with Gasparcolor paper, it is said.

THE OUTBREAK OF SLEEPING SICKNESS

THE present epidemic of sleeping sickness, encephalitis lethargica, raging in and around St. Louis is the worst in the history of the disease, according to information given to Science Service by the U. S. Public Health Service. Thus far the official record shows 129 cases and 12 deaths; and in previous outbreaks elsewhere not more than twenty or thirty cases have been reported in one place. The spread of the malady has been rapid, too: all the cases have been reported since the last day of July.

One thing which is puzzling public health officers is the curious distribution of cases in the present epidemic. Most of the cases and all but one of the deaths so far reported have been in the suburbs, with a total of some 200,000 population, while the city proper, with a population of about 800,000, has been much more lightly visited by the scourge.

Another unexplained feature is the high mortality among persons in middle life. Most of the deaths have been of persons between the mid-fifties and the mid-sixties.

The U. S. Public Health Service is cooperating actively with local health authorities. Dr. James P. Leake has been on the ground since the earlier stages of the epidemic, and Dr. Charles Armstrong joined him later. The Public Health Service has authorized the purchase of a supply of monkeys, which will be inoculated with virus obtained from the bodies of persons who have died of the disease, in an endeavor to obtain better scientific

knowledge of its nature and with the hope of eventually working out a method of prevention or cure.

As yet, the germ of sleeping sickness has not been found. It seems to be one of the filterable viruses—something apparently alive but too small to be seen with even the most powerful microscopes and able to pass through the pores of a fine porcelain filter which is able to stop all ordinary germs.

It appears to invade the human system through the nose, passing along the path of the olfactory nerves to the brain and thence down the spinal cord. If the resulting illness does not end in death it often leaves the victim mentally deranged.

The sleeping sickness of the temperate zone, encephalitis lethargica, is not to be confused with African sleeping sickness. The latter disease is caused by an animal germ that is quite visible under the microscope—a relatively large organism, in fact—and is transmitted from person to person by the bite of the tsetse fly.

THE DUTCH ELM DISEASE

DUTCH elm disease plays no favorites. Apparently no species of elm tree is immune to this deadly fungus, which is threatening the elms of America with the destruction that the chestnut blight visited on our native chestnut trees.

R. Kent Beattie, tree disease expert of the U. S. Department of Agriculture, who searched the Orient with good success for chestnut trees immune to the blight, holds out no such hope for elms to replace the American trees if the Dutch disease gets the better of the scientists and foresters who are at present fighting night and day to eliminate it from its foothold in New Jersey and the region around New York Harbor. All American species of elm on which the infection has been given a chance, whether by natural infection or deliberate experiment, have proved highly susceptible.

One species only, the Chinese elm, has an apparent immunity. But this immunity is only apparent, for when the tree is inoculated with the fungus it develops the characteristic brown markings in its young wood, although the leaves do not die and fall off as they do in other species. This permits the Chinese elm to harbor the disease and yet live; but it makes it a "carrier," just as there are human beings who harbor typhoid and other disease germs with no harm to themselves but with great danger to their neighbors. This tolerance on the part of the Chinese elm had led investigators to conjecture that the real home of the disease may be in the East. But this suggestion remains as yet only a suggestion: supporting evidence is still lacking.

One encouraging thing in the present situation, Mr. Beattie told Science Service, is the apparently restricted range of the present outbreak, serious as the trouble is within that range. Four trained scouts of the Department of Agriculture have within the past few days made a careful inspection trip for some distance into New England and up-state New York, and have found nothing to indicate the presence of Dutch elm disease in the territory they traversed.

Nevertheless, Mr. Beattie cautioned, every one who finds prematurely wilting, yellow or brown leaves on his trees, accompanied by brown streaks in the young wood, should regard these as dangerous symptoms. Samples of the wood should be sent to the nearest Dutch elm disease laboratory: in care of the Experiment Station, Wooster, Ohio, or in care of the Shade Tree Commission, City Hall, New Jersey.

ITEMS

THE white spot that now decorates the ringed planet Saturn is in reality the brightest of a row of spots strung over some forty degrees in longitude, or one ninth of the length of its equatorial belt, Professor Otto Struvé, director of the Yerkes Observatory, has informed Harvard College Observatory. Professor G. Van Biesbroeck, using the 40-inch Yerkes telescope, observed the passage of the spot over the central meridian, and using earlier data given by U. S. Naval Observatory observers, has found that the period of rotation of Saturn is 10 hours 15 minutes, a value that compares favorably with past determinations.

LATE summer rains, coming after the middle of August, have helped the country's short corn crop a little in places, but in general the benefit is not great, J. B. Kincer, chief of the climate and crop-weather division of the U. S. Weather Bureau, has announced after a survey of recent weather conditions over the Corn Belt. "In Iowa, progress was fair in about half the state, but poor in several dry areas," Mr. Kincer stated. The bulk of the crop is advancing in maturity, he continued, with a small amount safe from frost as early as the end of the third week in August. Some corn is drying prematurely and will be chaffy.

MALARIA research in the largest swamp in the world, conducted by scientists of the Hebrew University in Jerusalem, has received support for another year from the League of Nations, it has just been learned. The swamp is known as the Huleh Swamp, and is the breeding place for clouds of mosquitoes that keep the native population in a state of constant re-infection. A recent visitor to the malaria stations of Palestine has been Dr. Yao, chief of the Malaria Division, Nanking, China.

THE thrilling but one-sided sport of pursuing game animals across the desert in motor cars has been prohibited by Signor Badoglio, Fascist governor of Tripoli. He has also put the more conventional sport of coursing with greyhounds under the ban, as well as the capture of game with nets. This is part of a comprehensive scheme of conservation now being fostered in Italy. In the mountains of the Abruzzi, brown bear, ibex and chamois are now given complete protection; in Sardinia the wild sheep, female deer and laemmergeier, a great bird of the vulture family, may not be hunted. Throughout Italy many small birds hitherto hunted freely are now tabu.