SCIENCE NEWS

Science Service, Washington, D. C.

THE MEASUREMENT OF INVISIBLE GERMS

GERMS so small that they can not be seen with the most powerful microscopes have nevertheless been measured and their size has been determined by a new method developed by Professor H. Bechhold and Dr. M. Schlesinger, of the Frankfort Institute for Colloid Research at Frankfort-on-Main.

This new development is of particular importance because a number of disease germs, notably those of smallpox, measles, yellow fever, rabies or hydrophobia, and possibly influenza and the common cold, are so small that they can not be seen even with the most powerful microscopes. Because they are invisible and the classic methods of bacteriology are not applicable to them, many investigators have come to the conclusion that they do not exist at all, and that the maladies said to be caused by them are in reality chemical intoxications by some unknown poisonous substances.

It was found by the new method that the germ of smallpox is from 21 to 23 hundredths of a micron in diameter. One micron is one thousandth of a millimeter, which in turn is about one twenty-fifth of an inch. The germ of chickenpox is smaller, having a diameter of from 12 to 13 hundredths of a micron, which makes it only about half as large as the germ of smallpox.

The bacteriophage, which preys on the germs just as they prey on animals and human beings, is very much smaller than these two germs, however. Its diameter measures between 12 and 20 millimicrons. Since a millimicron is one thousandth of a micron, this shows that the bacteriophage is about one tenth of the size of the tiny chickenpox germ, for instance, in the opinion of Drs. Bechhold and Schlesinger, its very small size seems to prove that it is no organism but a special stuff.

The size of these tiny organisms was determined by a simple method of combined filtering and centrifuging. Professor Bechhold devised ultrafiltration methods and consequently was able to procure filters with very small pores, having a diameter of 1/250 millimeter. The centrifuge used made 10,000 revolutions per minute. Professor Bechhold found a general formula by which may be calculated the correlation between decrease of concentration and size of the particles of a semifluid substance centrifuged at high speed. From this formula and the known diameter of the filter pores, the size of the germs was determined. Inoculation into animals proved that the material measured was capable of producing the disease in question.

CENTRIOLES

MINUTE structures in the male reproductive cells, so small and fugitive that their existence has hitherto been doubted, have been given certain reality by the researches of Dr. H. Herbert Johnson, of the College of the City of New York. At a lecture before the section of biology, of the New York Academy of Sciences, Dr. Johnson gave the latest results of his work, together with a summary of the results of other researches in the same field, on which his own work has in part been based.

Dr. Johnson worked with the male reproductive cells of the cricket, because these give exceptionally clear, definite arrangements of the parts in which he was interested. He found that the "centrioles," or focal points towards which the heredity-bearing chromosomes move when cell division takes place, are definitely existing objects that survive the division of the cell and maintain their shape even when they are not actively at work. These centrioles are objects so tiny that many previous biologists had claimed they were merely distortions in the substance of dead cells due to the killing process. The most significant discovery, original with Dr. Johnson, was that in the crickets, due to a peculiar shape of the centriole, it could be definitely located in the living, unstained cell and thus can not be considered a distortion induced by death. Dr. Johnson has found that centrioles migrate with the sperm cell when it enters the egg to fertilize it, and he suggested that they may play an important part in the subsequent division and arrangement of the egg substance.

Another class of objects demonstrated by Dr. Johnson are the "dictyosomes," in connection with each of which is secreted a minute droplet of material which unites with other similar droplets collectively known as the "vacuome" to form a larger drop which takes its place at the tip end of the sperm cell. Certain chemical tests suggest the possibility that this vacuome may be very important in the sperm's entry into the egg, besides exciting a chemical response on the part of the egg, perhaps digesting a path in the egg substance for the sperm to pass through.

THE IONIC CONTENT OF AIR

CONCLUSIVE evidence that minute electrified particles of the air, known to scientists as ions, are the real cause of fresh, invigorating atmosphere is being sought at the Harvard School of Public Health in Boston by Professor C. P. Yaglou, assisted by L. Claribel Benjamin and Sarah P. Choate, technicians. These workers reported results of their research, at Cleveland, before the annual meeting of the American Society of Heating and Ventilating Engineers.

The studies consisted chiefly in measuring the number of ions in different kinds of atmosphere. They indicate that atmosphere which is considered "deadening" to the breather is likely to contain only a small number of ions per unit of volume.

Professor Yaglou told *Science Service* that at the present state of the research he would not be justified in saying that "dead" air can be made fresh and invigorating simply by increasing the ionic content with an electric apparatus. "The consensus of opinion among our experimental subjects," he continued, "seems to indicate that highly ionized air is fresher than air of

low ionic content, but the number of observations is too limited to draw definite conclusions at this time.''

Professor Yaglou and his assistants found that the common rate of ventilating buildings is entirely insufficient to maintain the normal ionic content of the air in a crowded room, the necessary rate of 160 cubic feet per person per minute being prohibitively high. But with electric apparatus they were able to keep the ionic content of air in a crowded room at a high figure when outdoor air was entering at the usual rate of ventilation of thirty cubic feet per person per minute.

''In contrast with the prevailing belief,'' they stated, ''the ionic content in unoccupied heated rooms did not differ much from that out of doors, and in cold weather it was often higher, owing probably to a temperature effect.''

The concentration of ions in the air changes both seasonally and daily. There were said to be more ions in the air during the summer than in winter, on clear days than on rainy, foggy or gray days, and, as a general rule, the concentration is higher during the day than at night. In nature, ions are produced by solar radiation, by cosmic rays and by radioactive changes in the soil of the earth.

THE RADIATION OF HEAT FROM THE SKIN

THE human skin is an almost perfect insulator against radiated heat. To get heat through it, the skin must itself be warmed up and allowed to do the radiating. This information is one of the results of research conducted by L. B. Aldrich, of the Smithsonian Institution, on practical problems connected with heating and ventilation of schoolrooms and similar places, where numbers of human beings sit for hours, warming each other and the surrounding atmosphere and furnishings with their bodily radiation. The technical results are published in full in a Smithsonian Institution bulletin recently issued.

After measuring with electrical instruments the heat radiated by a number of human subjects, Mr. Aldrich suspected that it might not all be coming by radiation from the surface of the skin. A part, he thought, might possibly be radiating directly through the skin. So through the assistance of a hospital surgeon he got a fresh piece of human skin, for which the original owner had no further use, and made direct tests. He found that it would stop heat waves almost completely. It therefore appears that the heat from the interior of the body must be transmitted to the skin, largely through the circulating blood, and then radiated from its surface, instead of being shot straight through it from beneath.

Mr. Aldrich applied his measurements to the practical heating and ventilating problems presented by a crowded schoolroom, using well-known physical and engineering formulae. In his report, he reduces his results to terms of common understanding. He says, in part:

''As a rough example, assume a class of students placed in rows, with spaces of two feet between students in a row, and the same distance between rows. To simplify matters, imagine each student to be cylindrical, one foot in diameter and four feet high. The four students nearest to a given student would occupy roughly 10 per cent. of the total space to which the central student is radiating. The four next nearest students exposed to the given student would occupy an additional 5 per cent., and the eight next nearest another 4 per cent. Summing up, the amount of space occupied by surrounding students would be about twenty-per cent. of the total space to which the central students radiate.

''If we reduce the space between students to only one foot instead of two and proceed to sum up in a similar manner, the area occupied by the other students increases to about 35 per cent. of the whole. For a spacing of three feet between students it reduces to only 10 per cent. In other words, when students are spaced one foot apart, the total radiation loss of each student is some 35 per cent. less than if he were alone in the room. When the spacing is two feet between students the radiation loss is 20 per cent. less than if he were alone, and when the spacing is three feet the radiation loss is 10 per cent. less. These rough figures serve in a general way to show the relationship between the spacing of students and the radiation loss of individual students.''

WEATHER AND THE GULF STREAM

THE Gulf Stream is not coming closer to the southeastern and central Atlantic coast and even if it should any change of its course would have practically no effect on the climate of the United States.

Thus may be summarized information gathered from the Hydrographic Office of the U. S. Navy and from the U. S. Weather Bureau in response to reports stating that movement of the Gulf Stream closer to the coast was partly responsible for recent abnormally warm weather.

Investigators of the Hydrographic Office stated that they have received no information which indicates a change in the course of the ocean current. It was pointed out, however, that since the limits of this current are not sharply defined and since it eddies and swirls beyond its normal boundaries, temperature readings may have been reported which without sufficient study might be taken to indicate that the stream has changed its position.

But Mr. W. F. McDonald, chief of the division of marine meteorology of the Weather Bureau, holds that in so far as the weather of the United States is concerned, there is little point to a consideration of the possibility of a new course for the current. Mr. McDonald pointed out that since prevailing winds over the United States and the North Atlantic ocean blow from west to east, the Gulf Stream has more effect on the weather of Europe than on that of this country. He also said that the temperature of the stream as measured in the Florida straits by boats plying between Florida and Cuba has not increased appreciably during or immediately preceding the warm weather.

Additional evidence to show the negligible effect of this current was given by J. B. Kincer, chief of the division of agricultural meteorology of the Weather Bureau. The states which are closest to the Gulf Stream and which should receive its greatest effect, Mr. Kincer said, were actually cooler than normal during the

winter of 1930–31, and for the entire record-breaking hot year of 1931 average temperatures rose less above normal in these states than in any other part of the country.

Influence of the almost entire absence of icebergs in the North Atlantic during the past season is discounted as a cause of the warmth by Commander Edward H. Smith, of the U. S. Coast Guard. Commander Smith, who has conducted expeditions to study the source of icebergs, says that the cooling effect of melting ice on the Labrador current is slight.

PAPERS PRESENTED AT THE NEW ORLEANS MEETING

(Continued from the issue of February 5)

FINAL scores of a shooting match in which the bullets were electrons and the targets were atoms of the rare atmospheric gas, argon, were reported to the American Physical Society by Professor A. L. Hughes and Dr. J. H. McMillen, of Washington University, St. Louis. It was found that most electrons bounce off atoms elastically, that is to say, without loss of speed. These electrons for the most part, come off at small angles, that is, they are deviated but a small amount from their original direction. Others of these elastically rebounding electrons are diverted through large angles. Certain large-angle deflections are preferred to others; the effect may be described as the production of electron haloes. This result supports the view that electrons can be particles and waves at the same time. In other collisions, an electron rebounds inelastically, *i.e.*, it gives up a part of its energy either to excite the atom, in which state it can give out light; or to ionize it, which is to say that another electron is ejected out of the atom by the colliding electrons. The colliding electron, as a rule, goes through the atom with but little change of direction, although it loses speed. If it ejects an electron from the atom, the ejected electron may come out in any direction, but with a decided preference for directions opposite to those of the colliding electrons.

HOW scientists of all nationalities are planning a concerted attack on the weather secrets of the Arctic and Antarctic during the year 1932–33 was described by Dr. Herbert H. Kimball, of the U. S. Weather Bureau, Washington, D. C. Weather forecasting in the temperate regions will be immediately aided by this work, Dr. Kimball explained. For practical forecasting purposes, atmospheric processes in the polar regions of both hemispheres play a predominant part in determining the weather of moderate latitudes. The original "Polar Year" investigations of 1882–83 have never been repeated, Dr. Kimball said. The planned expeditions for next year, involving the setting up of forty separate stations in the Arctic, will be the jubilee of the first polar year. Most of these stations will be in radio communication with high-power meteorological stations at low altitudes and so the results will be available for charting by forecasters all over the world on a uniform basis almost immediately after they have been made. Three chief classes of observations will be made under the Polar Year plan: magnetic, auroral and meteorological. Dr. Kimball's report dealt only with the work on weather. This work will include preparation of weather maps showing the temperature and pressure of the atmosphere, the wind velocity and the amount of moisture in the air. There will also be investigations of air currents and exploration by balloon and airplane of the conditions of the air over the polar regions.

BY using invisible ultra-violet light that can be seen by photographic plates but not by human eyes, it is possible to picture in greater detail the fine microscopic structure of various substances, Mr. A. P. H. Trivelli, of the Eastman Kodak Research Laboratories at Rochester, New York, reported to a meeting at the Franklin Institute. With ultra-violet light just beyond the limits of visibility it is possible to focus the special microscope with green visible light and then take the photograph with mercury vapor lamp light of 365 millimicrons wavelength. For shorter wave-lengths of the invisible light, the focusing has to be done in the dark by trial and error photographs. At wave-lengths of 180 millimicrons the air itself becomes opaque to the light and it is necessary to work in a vacuum or in an atmosphere of nitrogen. Quartz must be used for lenses in all ultra-violet light work, except that with the longest wave-lengths, but Mr. Trivelli found that at 150 millimicrons wave-length even quartz became opaque.

FOURTEEN points for the government of the atom nucleus have been formulated by Professor William D. Harkins, of the University of Chicago. The stability and formation of the ninety-two elements of the chemist's periodic table of atoms are intimately governed by them. They relate particularly to the atomic weight and the atomic number, or order number of the element in the table. Nature is most often even in making her atom cores, Professor Harkins finds. Nearly all atomic nuclei contain an even number of electrons. The atomic number and the number of protons in the nucleus are generally even, too. Elements of even atomic number, the newest data indicate, are ten times more abundant on the surface of the earth or on the sun. In meteorites the atom nuclei of elements of even atomic number are fifty times more abundant.

THE methods of measuring the Lenard or electron rays have been perfected by an investigation of Dr. Lauriston S. Taylor, of the U. S. Bureau of Standards. Lenard rays are obtained by pushing electrons through a vacuum tube under a pressure of several hundred thousand volts. By use of a small window of metal or glass the speeding electrons can be obtained in the air outside of the tube. As they have been used, since their first production in large quantities by Dr. W. D. Coolidge, for a great variety of chemical and biological purposes it is important to have an accurate method of measuring them. Three methods of measuring the rays were compared. Of these the use of a "Faraday chamber" was found to be most effective. This consists of two metal chambers enclosed one within the other and having openings through which the electrons may pass to the inner chamber.