SCIENCE NEWS

THE CHARGE OF THE ELECTRONS

Science Service

DR. A. W. HULL, of the General Electric Company's Research Laboratory, and Dr. N. H. Williams, of the University of Michigan, reported to the American Physical Society meeting at Ann Arbor, on November 29, that they have been successful in listening by radio to movements of electrons, the smallest particles of matter.

Using a vacuum tube radio amplifier, magnifying the sound a hundred thousand fold, the rain-like blows of many electrons on the plate of the tube produced a roar that sounded like Niagara in the distance. The sound is caused by bombardment of the plate by electrons, released from the hot filament. It is these electrons which carry the current and which make the operation of the tube possible. Dr. Hull therefore believes that the noise is a fundamental property of electron emission, a characteristic of the electron. The noise, due to the electrical oscillation, which is set up by the impacts of the individual electrons on the plate, is known as the Schrot effect and was predicted on theoretical grounds by Dr. Schottky, of Berlin.

Listening to the electrons was merely incidental to more technical researches undertaken by Drs. Hull and Williams. They were primarily engaged in measuring the electrical charge on the electron. This was first accomplished with great accuracy by Dr. R. A. Millikan, of the California Institute of Technology, at Pasadena, and winner of the Nobel Prize for physics last year. Drs. Hull and Williams were attempting to obtain the same results by a method differing from that used by Dr. Millikan.

Dr. Millikan's method of measuring the charge of an electron is based on the influence of gravity and of electric charges on minute oil "droplets." These droplets are so small that the effect of gravity causes them to fall only a quarter of an inch in ten seconds—they are about three hundred-thousandths of an inch in diameter and are observed in a powerful beam of light with a small telescope. They are then seen as specks of light against a dark background.

In the formation of these small drops with an atomizer, occasionally one becomes charged by friction; that is, it may carry an additional electron. If then the droplet is between two electrically charged plates it will behave differently from the uncharged particles. Those which are not charged will fall. The charged particles will be attracted to the positive plate. By the use of the proper voltage between the plates, these charged particles can be made to fall more slowly, held stationary, or caused to move upward. If two electrons instead of one are held by the droplet, the effect is doubled.

Drs. Hull and Williams have measured the charge of the electron in a different way, by means of the Schrot effect, and have opened a field for research which promises to add to the knowledge regarding the electron and its properties. Previous attempts were made by German scientists to make the electron audible, and to measure the charge of the electron by this method. Only approximate values were obtained, however. By the procedure used by Drs. Hull and Williams it is possible to obtain values of high accuracy. The measurements thus far made by this method give a value for the charge of the electron within one half per cent. of Dr. Millikan's value. The measurements were made while working with radio frequencies and studying vacuum tubes.

THE MISSING CHEMICAL ELEMENT

Science Service

ELEMENT 61, one of the five missing chemical building blocks of all matter, may soon be discovered. Professor C. J. Lapp, of the University of Iowa, before the recent meeting of the American Physical Society reported the results of his systematic search for this elusive element, which, though not heretofore detected by chemical or physical means, has had many of its properties predicted. Element 61 is known to be a rare earth, in the same class with cerium, whose oxides are used in the manufacture of gas mantles. There is a vacant space in the periodic table of chemical elements between number 60, neodymium, and 62, samarium, waiting to be filled.

One faint clew to missing element 61 has been found by Professor Lapp. By examining some samples of rare earths carefully prepared by his colleague, B. S. Hopkins, he has discovered a single and very faint line in the spectrum produced by X-rays reflected on to a photographic plate from the rare earth sample. This line is not claimed by any other chemical element and corresponds very closely in wave-length to a line predicted on theoretical considerations as belonging to element 61. On this evidence, Professor Lapp believes it likely that element 61 is present in his samples of rare earths in quantities of about 1 part in 2,000 or less.

Even if later research results in the definite identification of element 61 and its chemical isolation, it is doubtful if it will be of any commercial value. Very few of the rare earths are utilized in every-day life, and they are usually so mixed up one with the other that they are only occasionally separated with any degree of purity. The rare earths include such unfamiliar elements as: cerium, praesodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, cacciopeium.

There are now only five missing chemical elements, including number 61. All the rest of the 92 elements, from the lightest, hydrogen, to the heaviest, uranium, have been discovered. Numbers 43, 75, 85 and 87 are among the missing.

Many of the chemical elements have been first discovered in the spectrum and then found and isolated by chemical means. Helium was discovered in the sun in 1868 by lines seen in the spectrum of sunlight, and not until 1895 was it isolated by Sir William Ramsay. The latest conquest of physics and chemistry was the dis-

covery of element 72, hafnium, by the Dutch physicist Coster and the Hungarian chemist Hevesy working in the laboratory of Professor Neils Bohr in Copenhagen. Using first the X-ray spectroscope and then chemical methods, they discovered that hafnium frequently occurs in zirconium minerals and makes up about one two-hundred-thousandths of the earth's crust. It is more plentiful than the well-known metal, tungsten. The periodic table of elements, devised by the Russian chemist, Mendeleeff, in 1869, arranged the elements in logical order and allowed prediction of some of those then missing. Moseley, the young British physicist who was killed early in the world war, was able by applying X-ray spectroscopic methods to arrange the known chemical elements in an orderly series according to their atomic numbers. This classification is more enlightening than the Mendeleeff periodic table and has allowed more precise prediction of the properties of missing elements.

THE SPIRAL NEBULAE

Science Service

DR. EDWIN HUBBLE, of the Mount Wilson Observatory in California, according to an announcement given out by the Carnegie Institution of Washington, has made an advance in our knowledge of the distance of the spiral nebulae.

"The spiral nebulae are much too distant to admit of the use of the simple method of triangulation employed successfully in the case of the nearer stars," Dr. Hubble explains. "There are, however, powerful methods available which depend upon the possibility of determining directly the true or intrinsic brightness of stars from the characteristics of the light which they send to us. If the intrinsic brightness of a star is known, it is a very simple computation to derive its distance by comparison with its apparent brightness in the sky."

One of these methods, and that employed by Dr. Hubble in his investigation of the two brightest spiral nebulae, depends upon the fact that certain stars which vary in light in a definite way are known to show a direct relationship between the period of their light variation and their true or intrinsic brightness. The method has been used successfully by Dr. Harlow Shapley, of the Harvard College Observatory, in his studies of the distances of the globular star clusters and the Magellanic clouds of the southern hemisphere.

The investigations of Dr. Hubble were made photographically with the 60-inch and the 100-inch reflectors of the Mount Wilson Observatory, the extreme faintness of the stars under examination making necessary the use of these great telescopes. The resolving power of these instruments breaks up the outer portions of the nebulae into swarms of stars which may be studied individually and compared with those in our own system. From an investigation of the photographs, 36 variable stars of type referred to, known as Cepheid variables, were discovered in the two spirals, Andromeda and No. 33 of Messier's great catalogue of nebulae. The study of the periods of these stars and the application of the relationship between length of period and intrinsic brightness at once provided the means of determining the distances of these objects.

The results are striking in their confirmation of the view that these spiral nebulae are distant stellar systems. They are found to be about 10 times as far away as the Small Magellanic Cloud, or at a distance of the order of 1,000,000 light-years. This means that light traveling at the rate of 186,000 miles a second has required 1,000,000 years to reach us from these nebulae, and that we are observing them by light which left them in the Pliocene age upon the earth. With a knowledge of the distances of these nebulae, we find for their diameters, 45,000 light-years for the Andromeda Nebula, and 15,000 light-years for Messier 33. These quantities, as well as the masses and densities of the systems, are quite comparable with the corresponding values for our local system of stars, the one in which the earth is but a mere speck.

RHEUMATISM AND SUNLIGHT

Science Service

EVEN pigs need the sun. Recently doctors proved that children who were allowed to play in the sunlight were not troubled with rickets, or malformation of the bones. And now Professors Harry Steenbock, E. S. Hart and J. H. Jones, of the University of Wisconsin, have proved that sunshine is a preventive of the rickets, or rheumatism, common to hogs in northern states.

Dr. Steenbock in a series of experiments with rats had recently demonstrated that foods exposed to sunlight can be used as a cure for rickets. It remained to be determined whether or not exposing the pigs to sunlight would have the same effect.

Twenty-four pigs, reds and blacks, were used for the experiment. To discover whether it was the sunlight alone that prevented the disease they were divided into groups of six. Two of these groups were fed on yellow corn, which is rich in antirachitic vitamin, the other two were fed on white corn which contains less of the antirachitic vitamin.

Two of these groups were placed in "dark" pens and two in light. The "dark" pens could not be considered dark in the ordinary sense of the word, but the pigs in them were shielded from the direct rays of the sun. Both groups were placed in inside pens with out-door runways. The out-door runways of the pigs kept in the dark were roofed over with a composition roofing which kept off the direct rays of the sun.

The range of the experiment was from June to January. The time is important as the intensity of ultraviolet solar radiation varies decidedly with the season of the year. Rickets occur in children most often in the seasons when the sunlight contains less of the ultraviolet rays.

As a criterion of progress the pigs were weighed every two weeks. A great irregularity in growth was shown varying with the reserves of vitamin stored up by the animal from birth. It is impossible to produce rickets in any animal that has been long fed a ration rich in xitamin before the experiment. Dr. Steenbock concludes

that ultra-violet light can substitute for the vitamin preventing rickets, but not for the vitamin (A) which promotes growth, and that, in spite of radiation, growth will cease on exhaustion of stored reserves of Vitamin A. The yellow corn group grew better than the one on white corn. In the yellow corn group light was found to be extremely beneficial to the animals. Little by little, the pigs kept in the dark stiffened until they could hardly walk, even with extreme provocation.

On microscopic examination the bones of all pigs that lived in the light were seen to have a more regular structure and better arrangement of tissue than those that lived in the dark.

The experimenters conclude that "light in the absence of a sufficiency of the antirachitic vitamin is an important factor to consider in swine industry. In fact, there remains no question, in view of the conditions under which pigs are generally kept and fed in northern climes, that more attention should be paid to illumination."

EXPERIMENTS ON IMMUNITY

Science Service

A NEW method of combatingdisease germs has been discovered by Dr. H. W. Taliaferro, formerly of the Johns Hopkins University and now of the University of Chicago.

When dangerous bacteria invade the human body, the automatic defensive mechanism of the body usually throws fighting units, called antibodies, into the front line trenches of the blood. These protective substances kill the harmful disease organisms.

The new substance found by Dr. Taliaferro is related to such usual antibodies. But instead of wiping out the invading army of germs, it prevents it from perpetuating itself.

Working on a harmless blood parasite of rats, similar to the organism causing tropical sleeping sickness, Dr. Taliaferro found that the parasite, after an initial period of active multiplication apparently lost the power to reproduce its kind. Furthermore, by certain experimental procedure, he found that this peculiar occurrence is due to some substance produced in the rat's blood, and that blood serum containing this substance could be used to stop reproduction of the parasites in new infections.

This seems to be an entirely new kind of "antibody" action. Generally, serums, anti-toxins and like substances act either by destroying the disease-producing organisms or neutralizing their poisons. With this newly discovered substance, however, the case is different; it tolerates the existence of a few organisms, but literally forces race suicide on them by preventing them from multiplying. It remains now to discover whether in human sleeping sickness a similar action exists or can be induced. This problem Dr. Taliaferro is attacking.

African sleeping sickness is due to a microscopic animal known as a trypanosome and is closely related to the organism found in rats' blood. There are two varieties of tropical sleeping sickness in Africa, the Gambian and the Rhodesian; and one variety in the tropical parts of South America. The Gambian variety of Africa is the more serious one. All the tropical sleeping sicknesses are carried by insects, just as malaria and yellow fever are carried by mosquitoes.

Besides the tropical sleeping sickness, there is another entirely distinct disease in the temperate zone, called by the same name. This ailment, *Encephalitis lethargica,* which has been making some trouble in northern countries for some years, has never been traced to its cause, though it is probably due to an ultra-microscopic germ that can pass through the pores of a fine filter.

ITEMS

Science Service

SOAKING garden seeds to give them a running start also increases their speed through life, according to reports from the Plant Breeding Station at Proskau, Germany. Radish seed soaked for two or three hours in solution of magnesium chloride or magnesium sulphate give an increase in leaf and root development and a more than tripled yield in the most striking of the treated plants. Even soaking in pure water more than doubled the yield. Officials of the U. S. Department of Agriculture state that simply taking precautions to start with disease-free seed may lead to a false impression of stimulated growth. The department has been studying the effects of chemicals in destroying seed-borne parasites. Treated seeds may lead to normal healthy plants and such merely healthy plants may give the impression of leading a faster life when compared with sister plants from untreated seed. The Department of Agriculture is now launched on experiments which will determine whether there is a genuine speeding-up of the life of plants from the soaking of seed as the Proskau experiments suggest.

THE German Institute for Research in Human Food has reached the conclusion that beer does not amount to so much after all—that it is not nearly as effective a stimulant as tea. Results of a comparison of the two beverages were announced in Munich recently. A half liter of Munich beer containing about 15 grams of alcohol brought about an acceleration of mental action for about twenty minutes, followed by a period of noticeable depression lasting twice as long. A cup of tea, on the other hand, drove the mental capacity higher by about ten per cent. for three quarters of an hour, after which the subject of the experiment returned to normal without experiencing the ill effects that followed the alcoholic stimulant. The scientists warned, however, that the average amount of stimulating caffein in the ordinary cup of tea is about one tenth of the maximum medical dose so that there may be real danger if large amounts are imbibed at one time. A small amount of tea has relatively a greater effect than a larger amount.

EIGHT species of rare shore birds, *en route* from their summer homes in the far north to their winter feeding grounds in South America, made a stop of several days in Washington recently. It is many years since any of them has been seen in that vicinity, for they usually fly closer to the coastline, but a heavy storm is believed to have turned them from their course and led them to seek shelter there.