# SCIENCE NEWS

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## THE PRODUCTION OF ARTIFICIAL COSMIC RAYS



COSMIC RAYS, the most piercing radiation known to man, have been produced artificially for the first time at the Physical Institute of the University of Giessen by Professor W. Bothe and Dr. H. Becker. The process gains energy at the expense of the matter in the atom nucleus and thus realizes the old hope of tapping the energy of the atom.

Beryllium metal, bombarded with alpha particles from the radioactive element polonium, was in these experiments made to emit rays as penetrating as 14 million-volt x-rays so far unattained by man. The new rays are so penetrating that after passing through nearly 3 inches of iron they have lost only a third of their intensity.

Previous experiments on the bombarding of atoms with alpha particles, which are helium atom nuclei moving at high speed, have resulted in the production of proton rays, the speeding hearts of hydrogen atoms. Artificial transmutation of the target atom nucleus into another chemically different element had thus been attained by the loss of the hydrogen nucleus.

Drs. Bothe and Becker found, however, that beryllium gave off no protons when bombarded by alpha particles. The alpha particle entered the nucleus of the beryllium atom which at the same time emitted cosmic rays holding much more energy than the impinging alpha-particle projectiles.

Hitherto unknown carbon atoms of atomic weight 13 were thus formed from each of the beryllium atoms hit. This achievement constitutes a new type of transmutation of a chemical element. The process can be represented by an equation similar to those used to picture chemical reactions.

Six of the light chemical elements, Drs. Bothe and Becker found, gave the artificial cosmic or hard gamma rays under the action of the polonium alpha particles. These elements were: lithium, beryllium, boron, fluorine, magnesium and aluminum. Of these, beryllium gave by far the most intense secondary rays and therefore was most suitable for experiments. Some of these elements also emitted proton rays.

Professor Bothe has sent to Science Service the following account of his work:

"Our experiments show that energy is gained if any alpha particle is shot into the beryllium nucleus. That is to say, by addition of an alpha particle to the beryllium nucleus, a carbon nucleus of atomic weight 13 is produced which contains less energy than the two original nuclei together.

"These experiments give a hint as to the way in which the building up of the atom nuclei actually takes place in the universe: The heavier nuclei are produced by steps from the lighter. The hypothesis which Dr. Robert A. Millikan has made to explain the 'ultra-rays' (cosmic rays), that the heavy nuclei are formed direct by the sudden combination of a great number of protons and electrons, is accordingly very improbable.

"In still another connection the gamma radiation from beryllium is of interest in connection with the problem of the cosmic rays. The new rays are much harder than the known radioactive gamma rays, their penetrating power approaches close to that of the softest components of the cosmic rays. Thus in the beryllium rays one can study the properties of a gamma radiation which has approximately the penetrating power of the cosmic rays. As is well known, my earlier experiments with Professor Werner Kolhorster (reported by Science Service in January, 1930) showed that the properties of the cosmic rays are very different from those of a gamma radiation, and that the cosmic rays behave rather as a corpuscular radiation. Dr. H. Becker and I have now carried out the same experiments with the gamma rays from beryllium; it turns out that these still behave completely like a normal gamma radiation and quite differently from the cosmic rays. This is further strong support for the idea that the cosmic rays have a particle-like nature in the lower layers of the atmosphere.

"A series of other light elements, as well as beryllium, can be artificially excited to gamma ray emission. The production of artificial gamma rays is just as general a phenomenon as the breaking up of atomic nuclei. In this radiation we have a means of studying the structure of the lighter atomic nuclei; we are standing at the threshold of a 'nuclear spectroscopy.' Indeed the light atom nuclei are of special interest. They are most simply built, and we can here first expect to penetrate the still unknown principles of nuclear structure."

## THE TOTAL ECLIPSE OF THE SUN ON AUGUST 31



A NEW record for the number of astronomical parties observing a total eclipse of the sun will be set on August 31 of this year when the moon's shadow passes across eastern Canada and New England.

Word has been received of sixteen institutions whose representatives will be in the path of the shadow, and probably a number of others will also send astronomers to make observations only possible when the moon hides the sun. Hundreds of other professional and amateur students of the heavens will go to see this rare phenomenon, generally regarded as the most impressive of natural spectacles.

Eight of the scientific parties now planned are from American institutions, two from Canada, four from England, and one each from Russia and Japan. The path along which they will be located is about a hundred miles wide and passes south of Hudson Bay, across Quebec, over the St. Lawrence River from a point about

eight miles west of Montreal to one about 25 miles east of Three Rivers. Both these cities are therefore well within the band of totality.

Entering the United States, the path crosses northeastern Vermont, New Hampshire, except the southwestern corner, southwestern Maine, the northeastern corner of Massachusetts and Cape Cod. The shadow will cover the Atlantic coast between Salem, Massachusetts, and Boothbay, Maine.

The most northerly accessible point from which to observe the total eclipse is Parent, Quebec, on the Canadian National Railway about 185 miles northwest of Montreal. Two expeditions, those of the Dominion Observatory at Ottawa and the Royal Observatory at Greenwich, England, are expected to make this town their headquarters. At Sorel, Quebec, on the St. Lawrence River, close to the center of the path, the expedition from the McCormick Observatory of the University of Virginia will be located. Astronomers of McGill University, at Montreal, will make observations from their own city where they will be joined by a group from the University of London. Astronomers from Cambridge University will go to Magog, Quebec.

Most of the parties in the United States have chosen the vicinity of Conway, New Hampshire, including North and Center Conway, and Fryeburg, Maine, as observation points. Groups from the Lick Observatory of the University of California and the Sproul Observatory of Swarthmore College will go to Fryeburg. Near Center Conway will be a party from the Van Vleck Observatory, of Wesleyan University. Representatives from the Franklin Institute, Philadelphia, will go a little farther west, to Conway, according to tentative plans. The group from the Perkins Observatory of the Ohio Wesleyan University will locate at Douglas Hill near Sebago, Maine. At this same place will be a party from the Royal Astronomical Society, London.

Other expeditions from the Mt. Wilson Observatory, the University of Indiana, the Kwasan Observatory of the Kyoto Imperial University, Japan, and the Central Astronomical Observatory at Pulkova, Russia, are expected.

Most of the observations to be made by these astronomers, if cloudy weather does not make the elaborate preparations in vain, will be photographs of the solar corona. The corona is the outermost part of the sun, so faint that it is generally invisible because of the great glare from the light of the inner part. When the solar disc is covered by the moon, at the time of a total eclipse, the corona becomes visible.

In addition to direct photographs, in black and white, natural color and motion, made through cameras ranging from small kodaks to huge astronomical instruments as much as 85 feet long, spectroscopic photographs will be made of the corona to determine its composition and motion. Other spectroscopic observations will be of the flash spectrum, seen when the last sliver of sun is visible just before the moon completely covers it, or when the first bit reappears just after the total phase is over. Such observations give valuable information about the sun's atmosphere.

Still other observations to be attempted will be photographs of the shadow bands, which appear on the ground before and after the total eclipse, and of the shadow of the moon, as it sweeps over the earth. One observation that has engaged the attention of astronomers at recent eclipses will be lacking, however. This is the photography of stars close to the sun to determine whether their light is deflected by the solar gravitation, as predicted by Einstein. There will be no stars sufficiently bright in the sun's neighborhood at the time of the August eclipse.

## THE CHEMICAL ELEMENTS VIRGINIUM AND ALABAMINE

THE chemical method that enabled the finding of the last two chemical elements, virginium and alabamine, was itself discovered by following up an apparent experimental blunder, according to Professor Fred Allison, of the Alabama Polytechnic Institute, who spoke at the recent meeting in New York City of the American Institute of Mining and Metallurgical Engineers.

At first investigators doubted the power of the magneto-optic apparatus to detect one part of a chemical substance in a hundred billion of water which contained numerous other substances in solution. The apparatus, however, was perfected from an accidental beginning, and has proved itself completely successful. Besides making possible the discovery of the most elusive elements, numbers 85 and 87, it has proved the existence of the new double-weight hydrogen isotope and has discovered for the first time new isotopic atoms of seven heavy metals, including gold and platinum.

The four models of the apparatus in operation at Auburn have given completely concordant results in the hands of competent observers, even when the amounts of substance were too small to be found by any other method of analysis. An improved form of the apparatus at Emory University, Atlanta, Georgia, has been used by Professor J. L. McGhee and Margaret Lawrenz to verify Professor Allison's analyses.

Professor Allison believes that wide applications for the magneto-optic apparatus, which depends on the time lag in the effect observed when a beam of polarized light passes through a magnetized column of the liquid to be analyzed, will soon be found.

Not only will the method detect extremely small amounts, but it can tell how much is present. The magneto-optic method has the advantages that the analysis can be carried out in the presence of other substances and that the sample itself is not affected by the process as in a routine chemical analysis.

## FOG PARTICLES

THE smallest of the fog particles that hinder flying and ocean travel are so minute in size that 25,000 of them could be placed end to end within the space of an inch.

This was discovered at the Massachusetts Institute of Technology at the Round Hill research station where individual fog droplets for the first time were measured and photographed. Mr. Henry G. Houghton, Jr., made the fog measurements with a special microscope that catches on a greased slide the individual droplets as flies are trapped on sticky paper. Natural fog is allowed

to drift across the flat glass slide upon which the microscope is focussed and finely ruled lines and cross lighting allow the measurements of a hundred or more fog particles in a few minutes.

Fogs are not composed of particles all of one size, although one size usually is most prevalent. Different fogs have different particle sizes, but they are found to range from two twenty-five hundredths to one twenty-five thousandth of an inch in diameter (one to 20 microns).

These measurements were made as part of a comprehensive study of fogs, directed by Professor Edward L. Bowles and undertaken by Mr. Houghton and Dr. Julius A. Stratton.

Practical aids to aviation fog signalling may result as large particle fogs are known to be penetrated most easily by red light while fogs of very small droplets are best signaled through by green light. Other studies show that most sea fogs are caused by the formation of water about invisible grains of salt tossed into the air from breaking waves.

## THE OYSTER INDUSTRY AND WASTES FROM PULP MILLS

MILLS using the sulphite process in the manufacture of paper pulp may be prohibited from emptying their waste products into waters where oysters are grown. Investigation by agents of the U. S. Bureau of Fisheries, just made public, point to the sulphite waste liquor as the cause of the abnormal conditions in certain oyster beds. Recommendations have been made by the agents that pulp mills dispose of their wastes otherwise.

In response to a plea of oystermen in the Pacific Northwest, Drs. A. E. Hopkins, P. S. Galtsoff and H. C. McMillin, of the Bureau of Fisheries, made a study of conditions at Oakland Bay, on Puget Sound, where the once thriving oyster industry has almost ceased. They reported that the waste liquor given off in the sulphite process could be made to produce, experimentally, a high death rate, poor quality of meat and lack of shell growth among oysters. These abnormalities are now characteristic of Oakland Bay, into which a pulp mill empties its waste liquor.

When pulp is manufactured by the sulphite process, the chips of wood are cooked under pressure in a solution consisting primarily of calcium bisulphite with an excess of sulphurous acid. The resulting syrupy liquid, dark reddish-brown in color, contains, in addition to the substances of the cooking solution, nearly all the non-cellulose constituents of the wood.

Oysters, which the investigators placed in a mixture of this liquor and sea-water, either died outright or remained closed so much of the time that the food taken in was insufficient to produce healthy meat. The liquor was also shown to irritate the lining of the oysters' gills in such a way as to reduce the rate of feeding. The concentration of the sulphite liquor giving these effects was not greater than that now present in Oakland Bay.

Sewage and sawmill products in the bay were investigated and were held not to be responsible for the oyster setback. Checks on results obtained were made with oysters from other areas and with unpolluted water. Barnacles, mussels and certain plants were found not to grow on boats or other floating equipment in water containing sulphite liquor.

The condition of the oyster industry at Oakland Bay has become serious. Very few oysters form sexual products and spawn, and no set of oysters has been obtained for three years. It is believed that the pollution of the water in Oakland Bay by the sulphite liquor caused the death of practically every young, or larval, oyster.

## ITEMS

INFLUENZA cases increased throughout the country during the past week, reports received at the U. S. Public Health Service indicate. For the week ending February 13, a total of 6,664 cases were reported. The far west seems to have the largest outbreak. South Dakota reported an estimated total of 1,200 cases. The week before only 9 cases were actually reported from this state. Other states reporting high figures were South Carolina, Oklahoma, Oregon, Kentucky, Tennessee, Texas, Wyoming, Indiana and Wisconsin. Unfortunately, some quite populous states, among them New York and Pennsylvania, do not require the reporting of influenza cases, so that the actual total for the country can not be determined. Even in states requiring influenza reports, the figures do not always represent the full extent of the disease, partly because practicing physicians do not agree on the diagnosis of influenza, and partly because some cases of it never come to the attention of physicians or health officers.

"PARTHENOGENETIC" embryonic structures have been found in virgin guinea-pig ovaries several times in the past by Professor Leo Loeb, of Washington University Medical School, St. Louis, and he has now made observations that confirm his earlier work. Although the production of fatherless young is a commonplace occurrence in many animals, of which the ordinary aphid or plant louse is perhaps the most widely distributed example, it has never been observed among the higher vertebrates that bring forth their young alive, and even the abortive beginnings of such a process are regarded as extraordinary phenomena by biologists.

THAT chunks of iron ore are stuffed with steam and blown to pieces in a new metallurgical process which may become a wide-spread and money-saving method of treating ores was reported at the meeting of the American Institute of Mining and Metallurgical Engineers by Mr. R. S. Dean, chief engineer of the metallurgical division of the U. S. Bureau of Mines, and Mr. John Gross, metallurgist of the bureau, who discovered the process. Preliminary investigations have shown that the method requires little expense and labor and they believe that it may work something of a revolution in mining. Zinc and iron ores have been successfully shattered. The pores and crevices of the ore are first impregnated with water, then the ore is heated under pressure until the water turns to steam. When the pressure is suddenly released, the lumps of ore tear apart under the force of the expanding steam just as small grains of wheat can be blown into large fluffy particles.