

SCIENCE NEWS

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COSMIC RAYS

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THE purpose of our cosmic ray studies just completed in India was to get as accurate measurements as possible of the total cosmic-ray energy which gets into the earth at a series of relatively closely spaced latitudes. We have only relatively recently perfected the technique of making these measurements through sending sounding balloons with recording instruments essentially to the top of the atmosphere, and this made it imperative to measure these energies as a function of latitude, and that for the following reason:

Every one knows that the earth is a great magnet with its poles near the north and south geographic poles, their distance apart being, therefore, about 8,000 miles. This means that the earth's magnetic field stretches fairly far out into space, so that it should be easily detectable, say, 20,000 miles above the earth's surface. In this respect it contrasts sharply with the atmosphere, which may be likened to a thin skin, say, 100 miles thick, hugging closely to the surface of the earth.

Cosmic ray electrons in trying to push their way through this magnetic field experience a blocking effect, so that at a given latitude it requires an energy of the incoming cosmic ray particles of a definite and computable amount to get through normally and strike the earth's surface at all. By measuring, then, the amount of energy that actually gets through, say, at the magnetic equator, where it takes 17 billion electron volts to get through vertically, and at, say, Agra, where it takes $14\frac{1}{2}$ billion volts to get through, we can find just how many electrons are shooting through space and trying to get through with energies in the range between $14\frac{1}{2}$ billion and 17 billion volts.

In other words, by measuring the total amount of cosmic ray energy coming into the earth at a series of latitudes, say, ten degrees apart in going from the equator to the pole, we can determine just what is the distribution of energy among the superpower particles that are plunging through the heavens.

The importance of knowing this if we want to know how the cosmic rays are formed needs no argument. We went to India with very considerable equipment, then, for the sake of finding through balloon flights just how much energy comes in at the equator, how much at Agra in the central part of India, and how much at Peshawar in the northern part of India. It will take us some time to work up the results, and we are at present not concerned whether they support particular conceptions as to the origin of cosmic rays, or not. They must in any case give us either negative or positive evidence with reference to any particular conception.

We made, all told, some 45 flights in collaboration with the Indian Meteorological Service, spending about a month in Agra in central India, eight days in Peshawar right under the Khyber Pass, the northernmost point in India, and nearly a month at Bangalore in south India

close to the magnetic equator. We had most extraordinary cooperation from the British Indian Meteorological Service, which generously supplied us with all the hydrogen needed and much assistance in these observations.

We shall not know what precise conclusions to draw from these observations until we have worked up our data, which will take some time; but we are sure that we got the data that we went to India to secure, and it is just as significant whether the answer is positive or negative with respect to any particular conception. It is just as important to eliminate this theory or that as it is to support that theory or this.—ROBERT A. MILLIKAN.

THE NEW CYCLOTRON OF THE UNIVERSITY OF CALIFORNIA

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THE Rockefeller Foundation of New York City has given the University of California the sum of \$1,150,000 for the construction of a new and much larger cyclotron or atom smasher to be used in the radiation laboratory, of which Professor Ernest O. Lawrence is director. The university must raise \$250,000 from other sources to obtain this gift.

The plans for the new cyclotron call for a mechanism, or a fine integration of mechanisms, that will produce energies in excess of 100 million volts, as compared with the 33 million volts produced by the present 60-inch cyclotron. The weight of the new cyclotron will be 4,900 tons, or more than 20 times heavier and bigger than the present instrument.

The present cyclotron, the largest in the world, is said to have permitted striking new advances in the knowledge of the atom and also in the fields of biology and medicine, particularly through its production of artificially radioactive substances and its potent neutron rays. As compared to the 60-inch magnet of the present cyclotron, the magnet of the new instrument will measure 184 inches. It is hoped to produce a deuteron beam of 140 feet, as compared with the five-foot beam obtainable at present. It will be 58 feet long and 15 feet wide and will have an over-all height of 36.8 feet, of which 11.8 feet will be underground. From the emplacement the superstructure will rise to 25 feet. The estimated weight of the steel that will be used in construction is 4,500 tons, to which the copper windings will add 400 tons. A feature will be the underground location of the control room, 150 feet from the cyclotron itself.

The new cyclotron will resemble the present medical cyclotron, but in details it is planned to be the most distinctive engine of its kind. The designers in the radiation laboratory state that, because it is the first of its size ever planned or even contemplated, its actual operation may compel changes that can not be predicted at present.

At this stage its objectives are of a purely physical nature, with the structure of matter as the particular problem to be solved. However, as Professor Ernest O.

Lawrence, director of the radiation laboratory, points out, no one knows what new objectives it may light up or what new problems it may produce or solve.

A tentative site has been selected in the hilly section of the campus, to the east of the present radiation laboratory. Plans for the building also are in the tentative stage, but it is known that it will be devoted solely, in its beginnings at least, to the physical aspects of cyclotron research. There will be no biological laboratory as in the present plant.

ELECTRON PHOTOGRAPHS OF MOLECULAR STRUCTURE

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By whirling a heart-shaped rotating disk in front of a photographic plate against which electrons are falling, a new way has been found of making what might be called architectural blueprints from which the structure of molecules can be worked out. Professor Peter Debye, of Berlin, speaking at the meeting of the American Chemical Society in Cincinnati, described the new feat of getting photographs of the scattering of electrons in gaseous chemical compounds. These "bull's-eye" pictures—each consisting of a black spot with a series of concentric rings—enable chemists to calculate the structure of the molecules and help determine directly the distances between atoms in the molecule.

Professor Debye, who is director of the famed Kaiser Wilhelm Institute of Physics, stated that his twenty-four-year-old son is the inventor of the new advance in molecule portraiture. Professor Debye is now a visiting lecturer at Cornell University. His son had planned to present his new apparatus for his doctorate dissertation at Berlin this year but was in America when the war started last September. Knowing that his father was coming to America, he stayed over and is now in Ithaca, too.

Getting bull's-eye ring pictures of molecules is done by shooting electrons, with potentials of 30,000 volts, down a small vacuum chamber where they pass through the molecular gases being studied. These gases scatter them into the characteristic rings. The nearer the atoms are together in the molecule, the greater is the angle of scattering and the larger are the rings. The scattered electrons are allowed to fall on photographic plates and make permanent pictures.

The new procedure is to place a heart-shaped rotating disk just in front of the photographic plate on which the electrons fall. The size of the opening in this disk and its outside pattern enables Professor Debye to obtain the ring pictures with the outer rings much more clearly exposed and with better uniformity. In older ring pictures taken with other methods the center of the rings became severely over-exposed and darkened if scientists attempted to make clear the much fainter outer rings.

Professor Debye said that the 30,000 volt electrons produce waves corresponding to only a twentieth of an Angstrom unit of length. One Angstrom is one one-hundred-millionth of a centimeter. It is about the distance separating atoms in the molecules which Professor Debye studied. These molecules have been carbon tetra-

chloride, carbon disulfide, acetylene and ammonia.—
ROBERT D. POTTER.

INFRA-RED RECORDS OF THE ECLIPSE MADE IN TEXAS

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THE dimmed sun's rim was photographed and studied in the light of its invisible infra-red radiation, to get hitherto unrecorded data on the nature of its outer envelope of gases, during the annular eclipse on Sunday, April 7. The unique observations were made by an expedition from the McDonald Observatory of the Universities of Texas and Chicago, on a mountain top in the remote and rugged Big Bend country, 85 miles from the nearest railroad.

Complete success under a cloudless sky was reported by Dr. C. T. Elvey, leader of the expedition, although details of the results will not be available until after many days of computation and measurement. Instruments used were a four-foot telescope with a six-inch lens, equipped with filters to cut out all but the infra-red wavelengths, and a thermocouple hookup to translate heat from the radiation into electric impulses which were recorded on photographic paper. With Dr. Elvey were Dr. Fred T. Rogers, Jr., of Yerkes Observatory, who designed the special equipment, and Walter Linke and Arch Garner, both of the McDonald Observatory.

An expedition from the American Museum of Natural History, led by Wayne Faunce, vice-director, observed the eclipse from the top of a tall building in Jacksonville, Fla., and from an airplane at a three-mile altitude. Although the effect known as Bailey's beads, caused by the mountain peaks on the moon nicking the edge of the sun, could not be visually observed, it was picked up by photographs taken at the ground station.

The expedition from Brown University, led by Professor C. H. Smiley, which went to Thomasville, Ga., had the hardest luck of the day. Rain fell throughout the entire eclipse period.

While astronomers were watching events in the heavens, physicists of the Carnegie Institution of Washington were making observations of its effects closer to earth. They were concerned with changes in the ionization, or electric charges, of the "E" and "F" layers of the earth's "radio roof," which affect radio wave reflection and hence range and clarity of transmission.

Dr. L. V. Berkner, of the Department of Terrestrial Magnetism, reported that ionization of the "E" layer dropped sharply at the beginning of the eclipse, held steady until its end, then rose again to higher than normal level. In the "F" layer, ionization held steady until 15 or 20 minutes after the beginning of the eclipse, then dropped about 20 per cent., rising again as the shadow passed off the sun.

THE PRODUCTION OF ARTIFICIAL HORMONES

LARGE-SCALE laboratory production of artificial hormones necessary for reproduction and maintenance of life is foreseen as a result of the total synthesis of a new chemical announced by Drs. Lewis W. Butz, Adam

Gaddis, Eleanore W. J. Butz and Russell E. Davis, of the U. S. Department of Agriculture.

The new chemical is a steroid, like the sex hormones and other chemicals which animals and plants construct from the food they eat. This particular steroid, steradiene-tetracarboxylic acid, has never actually been isolated from the body. Dr. Butz and associates created it from acetylene, cyclohexanone, cyclopentanone and maleic anhydride, chemicals produced commercially from coal, water and limestone.

The synthetic sex and adrenal gland hormones which other scientists have made in their laboratories have been made from a simpler chemical isolated from the body and built into chemicals identical with the hormones. Because the Butz synthesis of the new steroid does not depend on first isolating a starting chemical from the body, it is expected to provide a quicker method of making the artificial hormones and also compounds related to cancer-producing substances used in the search for greater knowledge about cancer.

Details of the synthesis, which is part of a project designed to study factors concerned in reproduction in farm animals and was supported by funds provided under the Bankhead-Jones Act of 1935, appear in the current issue of the *Journal* of the American Chemical Society.

About 20 steroids have previously been synthesized in the laboratory by other workers in this country and abroad. These steroids have one feature in common, chemically: at least one of the four rings of the carbon skeleton has always been of a benzenoid type. Of the many steroids which have been found in animals and plants, less than 10 contain these benzenoid rings. Thus steroids of other types such as the adrenal and sex hormones mentioned, can not be easily made from the benzenoid type by known methods.

Dr. Butz pointed out that the newly developed method is able to produce steroids without these rings, the type that, according to present knowledge, predominates in nature.

A NEW CHEMICAL REMEDY

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DRAMATIC and speedy recoveries of five babies desperately ill with staphylococcus throat infections which in three cases required an artificial opening into the windpipe so that the babies would not choke to death were achieved by treatment with the new chemical remedy, sulfamethylthiazol, Drs. Donald Weisman and Hollis Russell, of St. Agnes Hospital, White Plains, N. Y., reported at a meeting of the New York Academy of Medicine.

Under the best possible conditions before the new chemical was available not more than half of the patients suffering from this infection of the windpipe, larynx and bronchi recovered, and the younger the child, the greater was the danger. Mortality from severe staphylococcus infections has been as high as 90 per cent.

An older boy with running ears, mastoid involvement and general blood stream infection with the staphylococcus germs recovered without operation under treatment with the sulfamethylthiazol which was also credited by the White Plains physicians with speeding the recovery

of another boy with severe osteomyelitis of the right thigh bone.

Peripheral neuritis, which has been reported in about one out of 100 patients following use of the new chemical remedy, was not observed in these children. Drs. Weisman and Russell suggest, on the basis of their experience and reports from other clinics where large numbers of children suffering from staphylococcus infection have been treated with sulfamethylthiazol, that the neuritis may be an affliction of adults only and that infants and children may have a greater tolerance for the chemical. Because of the danger of this complication, however, they advise using sulfamethylthiazol only under carefully controlled conditions and only in very severe cases of staphylococcus infection.

ITEMS

APRIL is the safest month of the year. The average of 285 deaths per day from accidents during other parts of the year drops to 251 in April, according to statistics issued by the Metropolitan Life Insurance Company. The reason for greater safety in April is that it is an in-between season, after the time when falls on the ice, smothering from too many covers or gas asphyxiation are hazards and before swimming, boating and lightning accidents begin to take their toll.

MAUNA LOA, Hawaii's giant volcano reported in renewed eruption, has a reputation as a very gentle dragon; it has never killed anybody, although there is a history of between 25 and 30 outbreaks of varying intensity since white men first began to take note of its activities in 1832. Like Hawaiian volcanoes generally, Mauna Loa is not addicted to the violent explosive type of outbursts that blast whole islands with clouds of deadly gas, as did Mont Pelée in the West Indies in modern times, or smother cities with showers of fast-falling ash, as did Vesuvius in antiquity. It just quietly pours out great wells of lava, which flow down its flanks like enormous sluggish rivers. These may destroy houses, plantations, whole villages if they happen to be in the way, but the population has always had time to escape.

THE theory that petroleum is probably being formed on the earth on a substantial scale, in contrast to the usual assertion that petroleum supplies are limited and irreplaceable, was advanced by Dr. Gustav Egloff, director of the Universal Oil Products Company, at the Cincinnati meeting of the American Chemical Society. He said, "It seems altogether likely that nature is continually producing more oil underground, perhaps at a faster rate than gas pressure or pump stroke can bring it to the earth's surface." Dr. Egloff states that all the evidence for his theory is not known, but he adds that the lakes, rivers and oceans abound in fish and mollusks closely resembling those found in oil-bearing formations. Dr. Egloff said that in the last few years the oil industry has been discovering new oil reserves at the rate of 1,000,000,000 barrels a year in excess of that actually used. Total reserves now known amount to 20,000,000,000 barrels or 16 years' supply. He forecasts that the depth of oil wells would increase from the present two miles to three miles and eventually to four and five miles below the surface of the earth.