SCIENCE NEWS

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PAPERS READ BEFORE THE AMERICAN PHYSICAL SOCIETY

RESEARCHES conducted 14,000 feet above sea-level on Colorado's Mount Evans make it seem probable that electrically neutral particles called neutrons cause some of the cosmic rays which continually bombard the earth. At a session of the American Physical Society devoted to cosmic radiation, which has engaged a large amount of the attention of physicists in recent years, Dr. Victor H. Regener, of the University of Chicago, and Dr. Bruno Rossi, of Cornell University, announced this conclusion. Their studies were made by batteries of cosmic ray detectors covered with layers of lead. These detect mesotrons, particles similar to electrons, but about 200 times as heavy, which constitute some 70 per cent. of the cosmic radiation observed at sea-level. Since mesotrons have a very short life, a minute fraction of a second, they can not have been created very long before they are detected. Hence, it is supposed that they are formed high above the earth by some other sort of radiation which comes from other parts of the universe. Much research has endeavored to find the nature of this original radiation. The detectors and lead plates were arranged so that the apparatus would respond only to mesotrons produced by a ray which has no electrical charge, and they did show some response. Particles known as neutrons, with the same mass as the proton, one of the principal atomic building blocks, but no charge, answer this description, and it is suggested that this form of radiation is responsible at least for some of the mesotrons reaching earth.

IN another paper presented at the same session, Dr. Thomas H. Johnson, assistant director of the Bartol Research Foundation of the Franklin Institute, suggested that more mesotrons come from the west than from the east in high latitudes because the mesotrons are bent by the earth's magnetic field after they have entered the atmosphere. There are about 20 per cent. more positive than negative rays, and these are deflected so that they come to the ground from the west. Dr. Johnson worked out the formulae for such an effect and finds that the calculated behavior agrees closely with that actually observed. He suggested that experiments intended to measure the relation between the numbers from the east and those from the west, and using various thicknesses of absorbing material, like lead, would yield useful data.

IRON in meteorites which have fallen from the sky is similar in its composition to iron from terrestrial sources, according to G. E. Valley and H. H. Anderson, of Harvard University. Practically all elements consist of several chemical "twins," called isotopes, which are made of atoms slightly different in weight. Iron consists mostly, more than 90 per cent., of the isotope of atomic weight 56. The rest is largely 54 and 57, with a slight amount of 58. The experimenters determined the isotopes in both meteoric and terrestrial iron, and found them to be nearly the same. The slight differences, they said, "can be accounted for by instrumental effects. We conclude that the abundance of the stable isotopes of iron does not depend upon the place of origin of the specimen within the solar system."

SCIENCE'S newest weapon for producing intense bombardments with fragments of atoms, a device called the induction electron accelerator, was described by Dr. D. W. Kerst, of the General Electric Research Laboratory at Schenectady, N. Y. The electron accelerator consists of a doughnut-shaped glass vessel with the air pumped out of it. It contains an iron core and is surrounded by a magnet consisting of thousands of segments of iron. A stream of electrons introduced into the glass vacuum chamber is whirled in the magnetic field at ever-increasing velocities until the particles are finally moving at almost the speed of light, 186,000 miles a second. In reaching this speed, the electrons make 200,000 revolutions, traveling a distance of approximately 60 miles and building up an energy of 2,300,000 volts. The present small apparatus, less than a foot in diameter, produces radiation energy equivalent in intensity to that given off by ten milligrams of radium. Larger models can be expected to give more energy.

THE MEANING OF WORDS IN MATHEMATICS

A LOGICAL system in which the word "and," for example, might have millions of distinct meanings was described before the meeting in Detroit of the American Mathematical Society.

Dr. J. Barkley Rosser, of Cornell University, told how this "many-valued logic," once considered by mathematicians as an interesting game, had been developed with serious intent at the request of a physicist, Dr. Fritz Zwicky, of the California Institute of Technology. He thought that it would be easier to explain the atom with such a system.

In ordinary two-valued logic, a clear-cut statement is either so or not so. Thus, if one alternative can be proved wrong, the other is assumed to be true. This is the principle of the "reductio ad absurdum," or "reduction to absurdity," which has gone unchallenged for centuries.

Many-valued logic declares that instead of the two possibilities, "so" and "not so," there are any number of possibilities. When the number of possibilities is six, for instance, these might be "certainly so," "probably so," "possibly so," "possibly not so," "probably not so," and "certainly not so." Sometimes a rather general question, such as "Do you favor short skirts for women?" might be answered in these ways, but according to many-valued logic, even a precise and clear-cut statement might fall into a number of cases.

Dr. Rosser stated that the system has proved to be much more complicated than was expected. "The reason for this is that the meaning of every mathematical word depends on the fact that one uses a two-valued logic for

ordinary mathematics. Allow more values, and you get more meanings for every word. What nobody had suspected was that you get a great many more meanings for every word. In a three-valued logic, there are 256 distinct meanings of the simple word 'and.' In a four-valued logic there are 14,348,907 distinct meanings of 'and.' And so on.

"All this complication makes things hard for the mathematician, but allows more freedom for the physicist. Imagine how many possible kinds of atoms a physicist could make out of electrons and protons with 256 kinds of 'and' to choose from, and how much more chance he'd have of finding one that worked the way it ought to."

AN UNKNOWN STAR IN THE CONSTELLATION OF AQUARIUS

THOUGH it "wasn't there" in his photographs, Dr. K.Aa. Strand, of the Sproul Observatory of Swarthmore College, has found a previously unknown star from the study of these same photographs. He announced his discovery at the meeting in Philadelphia of the American Philosophical Society.

The star is an invisible companion to a well-known double star, Zeta Aquarii, a member of the constellation of Aquarius, the water-carrier. This consists of two separate suns, which revolve around each other once in 400 years. Though first observations of them were made in 1779 by Sir William Herschel, Dr. Strand's photographic measurements are the most accurate so far. They are nearly ten times as precise as the best made hitherto.

In correlating these with the earlier figures, he found that the movement of the two stars was not uniform, but that there was a regular fluctuation from the expected motion, over a period of twenty-five years. These deviations "are entirely too large and too regular to be explained as systematic and accidental errors of observation, but they are satisfactorily interpreted as perturbations caused by a third invisible member of the system." That is, the gravitational pull of the unseen star pulls the others back and forth as it goes around them.

Dr. Strand concludes that the invisible companion has about one quarter the mass of the sun, while that of the entire system is four times the sun's mass. Its distance is about eighty-five light years. The two bright stars, which can be seen in a telescope, are separated by a distance about eighty-five times that between the sun and earth. The third star revolves around the brighter of the visible pair, at about twenty-six times the sun-earth distance, or about 2,400,000,000 miles.

Only twice before, said Dr. Strand, has a dark companion been found in such a way around a similar double star. The first such discovery was made in 1881, of a star in the constellation of Cancer, the crab; and the second was in 1905 of one in the great bear, Ursa Major.—JAMES STOKLEY.

THE HEIGHT AND INTELLIGENCE OF CHILDREN

PARENTS of children who are "too tall for their age" should not waste worry on their gangling offspring. On the contrary, they should be thankful they are that way, for they are very likely to be brighter than average as well as taller than average.

This was one of the points brought out in an address before the meeting of the American Philosophical Society by Dr. Franz Boas, professor emeritus of anthropology at Columbia University. For the past year he has been making a special study of the correlation between height-for-age and intelligence quotient in school children.

"Children short for their age had an intelligence quotient markedly under the norm," he reported, "those tall for their age, one above the norm." This finding is corroborated by the statistical evidence of another investigator, who found that "children of the same age are the taller, the higher the grade they had attained in school. In other words, their physical and mental development went hand in hand."

Great variability in human stocks, even in fairly closely related groups of individuals, was another point discussed by Dr. Boas. Variable traits included not only the obvious physical characters but also physiological and mental ones.

Exhibiting a chart which outlined strongly the great differences that can arise within such a related group, he pointed out: "This is one of the strongest proofs showing that it is an utter error to ascribe the same qualities to a whole population—too often called a race. The genetic lines composing a race are so varied that the assumption that all members are by heredity endowed with the same physiological and mental characteristics is as absurd as to claim that they are physically alike."—FRANK THONE.

THE OUTPUT OF SCIENTIFIC WORKERS

UNDER pressure of the war emergency, scientific workers in England have been trying to accomplish more by increasing the length of their working day. Now the question is being raised, Does the long working day really pay in increased output? How much can the day be lengthened without harm to the work and the worker? Some of the disadvantages of a very long work week for brain workers are discussed in a recent issue of *The Scientific Worker* published in London by the Association of Scientific Workers.

In the English industrial laboratories under study, three plans of working week have been tried. Under one plan, the work goes right on through seven days a week for a total of 66 hours. That would mean about nine and a half hours of work every day. Another plan is to have one day free in eight and work 57¾ hours a week. Under the third, workers put in 56½ hours a week and have one day free in each seven.

There is no good way to measure the amount of thinking a brain worker does in the course of his week's work. The value of what he accomplishes may not even be recognized during his lifetime. It is necessary in estimating the efficiency of this type of work to rely on the general impression among the staff.

At first more work was done in the long week. This made it possible for certain work to be accomplished earlier than would otherwise have been possible. But

now, the feeling is, little if any more work is being done than during the peacetime week of 44 hours.

Mental fatigue is so insidious that it leads to involuntary time wasting. In a normal working week, experiments in progress toward the end of a working day would be completed on overtime. Now such operations are not started late in the day. In a normal week, difficult problems coming up in the evening can be left to be tackled in the morning when the mind is fresh. After a long day and a short and disturbed night, the mind is never fresh. Scientific workers, it is explained, have a way of spending their leisure in a sort of busman's holiday fashion by reading scientific books or journals and by going to technical meetings. All this voluntary contribution to the value of their work is lost under a long work week.

Under plans giving free days, it was found that the scientific laboratory does not reap the benefit of staggered off-days as does the factory, where the purpose is to keep facilities in total use. Scientific workers usually work in teams; when any member of a group is away, the work is interrupted. Staff consultations are less valuable when some members are absent from every meeting.

Britain's Industrial Health Board summarizes in a recent government publication the research they have done in recent years on the effects of working hours on both the health and the output of workers. It used to be thought that worker's and employer's interests were opposed—the worker wanting plenty of leisure and pay, the employer wanting the most work for the least expenditure. But now psychological researches into industry have shown that the best conditions of work for the greatest output are exactly the same as those that give health and a low accident rate to the worker.

When hours are long, frequent rest periods were found to be essential. Psychological fatigue can be relieved best by rest pauses combined with a rotation of operations. Ventilation is important in preventing fatigue and reducing accidents. Ventilation and illumination provide new problems under blackout conditions.

It is pointed out that hours of work must be considered in connection with out-of-work requirements of the workers. In some of the laboratories studied, workers had to spend as much as three hours in travel getting to and from work each day. This time can not be counted as working time, but neither is it contributing to the rest or recreation of the worker.—MARJORIE VAN DE WATER.

ITEMS

THAT Rumania's ruinous earthquake was born far beneath the surface of the earth is indicated by word received by Science Service. The focus, or actual rock slip that started the tremors, was 150 kilometers (93.2 miles) down, according to calculations made independently at the Seismological Laboratory, Pasadena, Calif., and the headquarters of the Jesuit Seismological Association in St. Louis. At St. Louis the epicenter's location is calculated as in approximately 46 degrees north latitude, 27.2 degrees east longitude.

SHORELINES of a sea that 450 million years ago flowed where now the Rocky Mountains rise were traced during the past summer by Dr. Charles E. Resser, paleontologist of the Smithsonian Institution. Fossils of animals that once lived in its waters were his guides. This sea, dating back to the Cambrian geologic period, stretched from Alaska to Lower California. High land, about where the Sierra Nevada now stands, was its western boundary. To the east, there was lower land near the present location of the Rockies. Dr. Resser was able to tell where the sea shoaled out toward the shorelines by the presence of fossil beds considerably thinner than the normal bottom deposits already known.

THE fastest climbing airplane in the world, able to ascend more than a vertical mile in a minute, has just had its first public demonstration. Made by the St. Louis Airplane Division of the Curtiss-Wright Corporation, and known as the Curtiss Model 21B, it is a highly streamlined, single-place, low-wing monoplane, powered by a Wright Cyclone engine. It is one of a large number now being built. A speed of 330 miles per hour can be attained, which gives it great maneuverability, and increases the difficulty of ground forces in locating the ship. It has four machine guns, which fire through the propeller disk, as well as radio equipment and military aircraft accessories.

BUSES operated by Diesel engines have proved satisfactory in more than a year's service between Chicago and California, according to W. A. Taussig, of the Burlington Transportation Company, speaking before the meeting of the National Fuels and Lubricants Committee of the Society of Automotive Engineers at Tulsa, Okla. In the first few months of operation, during the summer of 1939, a great deal of trouble was experienced with engine failure. However, these difficulties were overcome and changes were made in the engines to improve their service. As a result, seventeen more buses were added to the original fleet of twenty-one. "A fuel saving of approximately 30 per cent. has been realized by the introduction of Diesels," Mr. Taussig stated. "While there have been some exceedingly discouraging experiences in the past, it now appears that the hardest part of pioneering is over, and unquestionably, in the future, more and more operators will avail themselves of the possibilities of fuel economies through Diesel operation."

Two kinds of organic molecules have been rendered visible by the electron microscope in Germany, according to information reaching Dr. Stuart Mudd, of the department of bacteriology of the Medical School of the University of Pennsylvania. Dr. Mudd is chairman of the committee on the electron microscope of the National Research Council. The organic substances, the molecules of which have been made visible, are hemocyanin and edestin. Both are proteins. Hemocyanin or hematocyanin is a blue respiratory pigment in the blood of mollusks and arthropods. Edestin is a pure crystalline protein obtained from oil of castor beans, hemp seed and other seeds.