SCIENCE NEWS

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DETECTING DEVICE FOR COSMIC RAYS

THE largest detecting device ever built for the study of cosmic rays was announced at the meeting of the American Physical Society, in New York City, by Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute.

The device is essentially a ten-story "apartment house" consisting of ten tiers of Geiger-Muller cosmic ray counters arranged in banks, with 18 to each tier. The 180 separate devices enable scientists to detect the passage of cosmic rays and to see how they may produce multiple collisions.

Each Geiger counter is connected to its own electroscope which registers the passage of a cosmic ray through each individual counter. Tiny beams of light from the leaves of each electroscope are sent, by intricate mirror systems, to a large ground glass screen on which appear 180 spots of light. As a cosmic ray goes through the entire apparatus many of these little light spots oscillate back and forth. By taking automatic photographs of the passage of each cosmic ray scientists obtain pictures of the actual paths of the rays through the apparatus. The visible effect is something like looking at the side of a skyscraper with all its many windows lighted and then noticing that certain of the windows have their lights flickering.

In the apartment house of Geiger counters—which is about five feet high over all—the "roof" consists of ten centimeters of lead. Each floor of the pile consists of one centimeter of lead. The large thickness of lead insures that only the most penetrating cosmic rays will pass through the apparatus and make the counters record. Moreover, to insure still greater sorting out of the less penetrating cosmic rays, the whole device stands under a large tower containing 30 feet of water. Thirty feet of water corresponds to the same amount of material as is contained in a vertical column of air right up to the top of the earth's atmosphere. Thus the water column, in effect, enables scientists to double the earth's atmosphere, for purposes of their measurements.

It is possible with the apparatus to see how a single cosmic ray passes through the entire apparatus from top to bottom and to see also how it sometimes is changed from one into two particles. These "progeny" of the parent particle may, in some cases, also become parents and so on. Thus the new device acts in many ways like a robot "census taker" for cosmic rays, keeping track of their "birth rate" and enabling scientists to compute a sort of "mortality table" for their life and death.

The usual birth and death of cosmic ray particles in the atmosphere is not too frequent, but when they are made to pass through the huge water tower and then through the additional lead the production of cosmic ray offspring is greatly increased. In effect the scientists are speeding up the "evolution" of impacts produced by cosmic rays.—ROBERT D. POTTER.

THE MEASUREMENT OF THE INNER ATOMIC BINDING FORCE

FOR the first time the value of the enormous electrical binding force within the cores of atoms which enables the matter of the visible world to hold itself together instead of disintegrating into simple atoms of gaseous hydrogen has been measured exactly. This inner attractive binding "cement" of the universe is a force which is equivalent to 11,000,000 electron volts. It acts only when the protons—the building blocks of the atoms—come within one tenth of a millionth of a millionth of an inch apart.

The new quantitative measurement of the nuclear force was described in reports to the American Physical Society by Professors Gregory Breit and Raymond G. Herb, and Drs. D. W. Kerst, D. B, Parkinson, G. J. Plain, H. M. Thaxton and L. Eisenbud, of the University of Wisconsin.

The new Wisconsin studies are an extension of the work by Drs. M. A. Tuve and L. R. Hafstad and their colleagues of the Carnegie Institution of Washington, which earlier led to the discovery of the basic binding force within atomic nuclei.

These earlier experiments studied the reactions of protons, scattered by other protons, over the energy range from 600,000 to 900,000 electron volts. The new work at Wisconsin, using the electrostatic "atom smasher" of that laboratory, has extended the range of measurement from 850,000 to 2,400,000 electron volts energy. This amounts to the widening of the experimental field of study by a factor of from four to five times.

Simultaneously with the Wisconsin tests has been a repetition of the study of the lower energy range at the Carnegie Institution, which has a higher order of accuracy than their original experiments. The two sets of independent data supplement and confirm one another and have made possible the new and better fixation of the energies present in the nuclear force and the distance, within the atom, over which it acts.

"HEAVY" WATER

PROGRESS in explaining some of the mysteries of heavy water, which has a density 10 per cent. greater than ordinary water, was reported by Drs. Victor K. LaMer and Evan Noonan, of Columbia University, at the symposium on intermolecular action of the American Chemical Society at Brown University.

Instead of using ordinary water in batteries, heavy water was used and it was found that the electromotive force was increased by 4.4 thousandths of a volt.

Dr. LaMer explained that it will now be possible to measure the exchange of hydrogen for deuterium—the heavy double weight kind of hydrogen—which takes place in the formation of heavy water. He said: "Up until the completion of our investigation, this change of atoms was measured by the resulting chemical properties. Such chemical measurements are not as accurate as those performed electrically.

"The results of our experiments also furnish an explanation as to why heavy water is separated from light water during electrolysis. A very small per cent. of heavy water is present in all ordinary water. In order to separate the two constituents, an electrical charge is run through the water by means of two submerged metal poles called electrodes. The hydrogen ion in the ordinary water takes on an electron from the negatively charged electrode and goes off in the form of hydrogen gas. In order for a similar reaction to occur in the deuterium ion, an electric force 44 thousandths of a volt stronger is needed. The hydrogen, therefore, is driven off first leaving behind heavy water with its deuterium content.

"Previously, it was thought that the amount of electrical force necessary to change the deuterium ion into deuterium gas was only four millivolts, or 4 thousandths of a volt, greater than that required for hydrogen. The real explanation of how heavy water is separated comes out more clearly when the new measurements are taken into consideration."

MEASUREMENT OF THE MILKY WAY

A NEW measurement of the dimensions of our own island universe, the Milky Way, was presented to the American Astronomical Society, meeting in New York City, by Dr. Harlow Shapley, director of the Harvard Observatory.

By study of the useful cluster-type Cepheid variable stars, whose distances can be readily determined, Dr. Shapley found that the globe of stars surrounding the dense disc of the Milky Way is more than 60,000 light years thick. Dr. Shapley stated that the most distant objects of this globe are farther away than the Magellanic Clouds, our satellite galaxy neighbors. Thus, these external systems may, in a tenuous way, be said to lie within the globe of stars that constitute the outer fringes of the Milky Way. Probably 95 per cent. of all known stars, whether variable or not, are within a thousand light years of the Milky Way plane. But the observed cluster-type variables extend outward from that plane to distances of 50,000 light years or more. Evidence that the extremely distant Cepheids are part of the Milky Way system lies in the fact that the "population density" of these stars, or the average number of stars per unit volume of space, falls off rapidly at greater distances from the Milky Way.

At a distance of 30,000 light years from the plane the density is about one thousandth of that near the plane, Dr. Shapley said. Clearly then the stars are members of our system, and do not represent a random distribution of stars through space.

Dr. Shapley studied the several hundred cluster-type Cepheid variable stars lying in the high galactic latitudes, that is, quite far from the Milky Way plane, and free from the low-lying absorbing clouds which make measurement of distances difficult. Most of the high latitude stars were found in surveys of faint variables carried on at the Harvard Observatory.

COMPOUNDS OF FLUORINE

COMPOUNDS of the corrosive gaseous element fluorine as the materials which are able to produce thin films on optical glass that will increase the transmission ability to 99.6 per cent. was announced by Drs. C. Hawley Cartwright and A. Francis Turner, of the Massachusetts Institute of Technology, to members of the American Physical Society, meeting in New York City.

Simple compounds of fluorine with lithium, magnesium, calcium and sodium all produce thin films which give the amazing optical property of increasing transmission through glass optical parts.

The discovery is of great importance in all complex optical instruments like cameras, spectrographs and periscopes where many prisms and lenses are employed and where each glass-to-air surface shows a loss of light due to reflection. The use of the new films, which are evaporated on to the glass in the research, decreases such reflective losses.

At first sight it seems paradoxical that the placement of anything on a transparent optical surface, be it a film ever so thin, could possibly increase the transmission of the optical glass. And yet this is accomplished in the new scientific advance.

Light incident on a piece of glass is ordinarily split into two parts. The major part goes through the glass and is transmitted. The other, smaller part is reflected at the surface, comes backward and is lost for transmission purposes. However, if a film of magnesium fluoride, for example, is placed on the surface of the glass, the length of the reflected light waves can be so altered that they will vibrate just out of phase with the oncoming wavetrains of the incident light. By suitable adjustment of the reflected light pattern the incoming waves can be made to cancel the reflected waves and the reflection, instead of being five or ten per cent., can be reduced almost to zero. The crucial point is that this light energy, which has been annulled by the interference effect, is not lost but reappears in the transmitted beam of light and shows up as an increase in transmission.

The films used have thicknesses about one quarter the wave-length of a ray of green light in the visible spectrum. The films themselves are invisible and can only be seen by the brilliant colored patterns they produce by interference in quite the same way that a thin film of oil on a mud puddle will show iridescent colorations.

The announcement coincides with that of scientists at the General Electric Company, who have reported the use of what has been termed a thin "varnish" film for coating glass to obtain comparable transmission properties. The composition of the "varnish" film was not announced.—ROBERT D. POTTER.

HIGH PRESSURE AND CHANGE OF COLOR IN ORGANIC SOLUTIONS

FOR the first time strong color changes have been produced in organic solutions by the mere application of high pressures, it is reported by Drs. R. E. Gibson and O. H. Loeffler, of the Geophysical Laboratory of the Carnegie Institution of Washington, to the symposium on intermolecular action of the American Chemical Society at Brown University.

The discovery of solutions in which there is found no evidence of chemical compound formation in the usual

sense, raises new questions about the origin of color. For a long time it has been known that when faintly yellow nitrobenzene and colorless aniline are mixed, a deep orange color is produced. But the newest discovery is that when pressures of 1,000 atmospheres (roughly 15,000 pounds to the square inch) are applied to such solutions they change their color markedly, becoming more red as the pressure increases. So new is the work of Drs. Gibson and Loeffler that the absorption spectrum of the colored solution has not yet been measured in detail. But the color change with pressure can readily be seen with the eye aided by a light filter. Moreover, the change can be confirmed by photographing the spectrum and showing that the light transmitted by the solution decreases as the pressure increases.

The implications of the new discovery strangely link pressure, ordinarily considered a purely mechanical happening, with color, which is known to be intimately bound up with happenings within molecules and atoms. Whether practical applications of the new knowledge will be realized is still a speculative matter. One might picture the possibility, however, that color changes would provide a quick, easy method of estimating pressure changes in high pressure apparatus or devices.

What occurs in the solution of nitrobenzene and aniline when the pressure is applied is still a matter of speculation at present. What may happen is that the pressure increases the number of times a second the aniline molecules bump into the nitro groups, thereby increasing the number of times temporary formation of unstable compounds may occur. These unstable aggregates may account for the color of the solution. A tentative, preliminary hypothesis might suggest that the movements of electrons between the aniline and nitrobenzene in this temporary union could occur so quickly that the color change could occur during the much slower time of actual impact between molecules.

Whatever the actual facts of the strange color phenomena may turn out to be, a curious kind of intermolecular behavior has been found. Further research may throw more light on the subject and perhaps explain it sufficiently to bring new knowledge of the origin of color in nature.

ITEMS

How he has given blood type tests to mummies of Aleut people who lived, and died, and dried up in the Aleutian Islands off Alaska, long ago, was reported by Dr. P. B. Candela, of Brooklyn, to the American Anthropological Association. Dr. Candela said that he detected the blood types of the Aleuts by making chemical tests of ground-up bone specimens from mummies of 30 pure-blood Aleuts. The mummies were among those discovered by Smithsonian Institution expeditions. The four types, or groups, of human blood, which have gained public notice in court tests of paternity, have use in scientific studies of human races. Widely separated tribes and peoples may belong predominantly to one blood group, which may prove to have significant meaning for the origins and history of human races. The Aleuts differ from any North American Indians in that some have blood in the group called B. One fifth of the Aleut mummies that he tested belong in this group. This finding fits in with the view of anthropologists who usually class Aleuts and also Eskimos separately from the Indians who peopled the rest of America.

CENTRIFUGAL dust collectors were described by C. B. Shepherd and C. E. Lapple, of E. I. du Pont de Nemours and Company, before the symposium on fluid dynamics of the American Chemical Society, meeting in Pittsburgh. Commonly they are known as "cyclones." The tornado dust traps are really two whirling spirals of air, one inside the other and traveling in opposite directions. In the dust traps a stream of air rotating at high velocity moves downward. When it reaches the bottom of the device it is turned upward and comes back inside the outer air stream, whirling all the while. The action of these counter-flowing air streams is now being used to trap particles only 4 ten-thousandths of an inch in diameter.

DR. A. I. HALLOWELL, of the University of Pennsylvania, speaking before the American Anthropological Association, stated that ink blots can be used by science as a key to what goes on behind the Indian's impassively calm face. By showing a set of ten ink blots, as a psychology test, to Indian chiefs, conjurers, good hunters and bad hunters, and other types, he found that the Indians' remarks as to what the blots look like provide natural and significant clues to Indian thoughts and emotions. The ink blot test, devised by a Swiss psychologist, has been successfully used with mental patients and criminals, as well as with normal people.

MEASUREMENTS of the electric forces exerted by molecules, which constitute in effect little magnets, are bringing out new facts about the relationships between molecules in liquids, according to a report to the symposium on "Intermolecular Action" sponsored by the American Chemical Society at Brown University. Many molecules, explained Professor Chas. P. Smyth, of Princeton University, can be regarded as having their electricity so arranged as to form positive and negative poles. In this respect they resemble magnets. The more powerful the pole, and the greater the distance between them, the stronger the force exerted by thm on surrounding charged materials. This force is called the "dipole moment" of the molecule. The dipole moment explains the structure of molecules and its measurement and is one of the best ways of interpreting molecular structure.

A STRANGE and as yet unexplained phenomenon occurring in the process of vaporization of a liquid or solid was described by Professor Joseph E. Mayer, of the Johns Hopkins University, at the symposium at Brown University. It has been discovered that instead of changing immediately into the gas "phase" familiar to chemists, every substance, even though composed of the same single kind of molecule will, at a "critical region" of temperature and volume, apparently become two different gaseous materials. These two components do not mix readily and differ in that one of them is denser or heavier than the other and stays in the bottom of the vessel.