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PAPERS READ BEFORE THE CHICAGO MEETINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MAN'S superior brain makes it possible for him to live in a world of extreme kinds of weather and other varying conditions, according to Professor James Barcroft, the British physiologist, a Century of Progress guest. The highly evolved brain of the human being holds unconscious control of his blood's chemistry and physics. The resulting constancy of his blood conditions make him relatively independent of heat, cold and other changes in the outside world that hamper the lives of his less fortunate lower animal kin. In the evolution of life, as pictured by Professor Barcroft, efforts of the lowest organisms to make themselves more at home in the world were at first aimed merely at so arranging their own lives that outside conditions would be less hard on them. They did not make much progress at changing and controlling their own internal conditions. Higher in the evolutionary scale, Professor Barcroft believes that the first steps toward internal regulation were chemical. Then control by the nervous system began to assert itself until finally the brain became dominant in maintaining the continuing uniformity of the blood.

PROFESSOR C. U. ARIENS KAPPERS, of the Central Dutch Institute for Brain Research, Amsterdam, told of researches that upset the old idea that the shape of the skull is always determined by the growth of the brain in its earlier stages. He has found that the skull often determines the shape and size of the brain. The small brain of a fish has plenty of room, even in the small space allowed it in the fish's skull. On the other hand, the bird's skull compels the brain it contains to fold and pack itself closely to make use of relatively limited space. Similarly among human races the various skull types—long, medium and broad—have been shown to influence the arrangement of the parts of the brain. There is, however, as yet no evidence that this influence of skull on brain makes any one race superior to another.

POTENTIAL food substances equivalent to twenty thousand times the wheat harvest of the world are dissolved in the waters of the Atlantic Ocean, according to Dr. August Krogh, the Danish zoologist. This immense amount of organic material is wasted unless it is found that, as some investigators have suggested, bacteria and microorganisms, as yet unrecognized but possibly existing in the depths of the sea, are turning it into food that larger units of sea life can eat and thus utilize.

HEREDITY is not a matter of chromosomes and genes alone. The jelly or protoplasm of the cell that surrounds these specialized living bits within the cell has much to do with whether people are tall or short, blonde or brunette. Professor Richard Goldschmidt, of Berlin's Kaiser Wilhelm Institute for Biology, reported that experiments on lower animals show that the cytoplasm, or bulk of the cell, has a distinctly modifying action on the genes, or chromosome units, that American research in the past three decades has shown to be the bearers of heredity. Genes give orders, but Dr. Goldschmidt's conception is that the surrounding cytoplasm does not always stick to the ordered plan, but acts like craftsmen who sometimes insert their own innovations.

WHEN motion stops, the organism is dead. This is the thesis of the French biologist, Dr. Jean Dufrénoy, of Bordeaux, who explained that within the living plants and animals that we consider the most stationary and motionless there is a ceaseless and intense motion of the protoplasmic jelly that makes up their cells. The more alive a cell is, the more furious is its motion, presenting a large surface to the nourishing sap or liquid. When death comes, three things happen: The protoplasm stops moving, its surface decreases markedly, its smooth unmarked granules break up into granules that can be seen only with the powerful ultramicroscope.

DR. EMILIO MIRA, of the University of Barcelona, Spain, speaking before the psychologists, stated that fear, rage and affection are the three basic human emotions that form the foundation of human moral behavior typ Fear gives rise to moral systems that express themselves in prohibitions and compulsions. Among children and people of low evolutionary level such systems are most fully developed. Rage induces the morals of anarchy and focuses upon material pleasures. True and human morality, in Dr. Mira's definition, is based on the third emotional state of affection.

THE Tropics would be hotter than they are and the Polar regions would be colder, were it not for the fact that there is an immense aerial interchange of heat in the winds, according to Professor J. Bjerknes, Norwegian meteorologist, also a guest of the Century of Progress. The most heat from the sun arrives upon earth in the equatorial zones and the least at the poles. The equatorial zone receives more heat than it radiates away and the polar caps receive less than they lose. The air transport system used by the Tropics in sending their surplus heat to the Arctic and Antarctic is the winds. Professor Bjerknes computed that it would take 303 millions of tons of air traveling across latitude thirty degrees to do this. Large as this sounds, the wind need travel only about six feet a second. Professor Bjerknes visualizes the atmosphere dividing itself into sections that can be called compartments and each maintaining its own circulation, with the usual trade winds nearer the surface and in some cases an anti-trade wind rushing along much higher. To get more information on just how and when the winds blow to equalize the heat on the earth, Professor Bjerknes urged investigators to send up sounding balloons with radio reporting weather instruments to signal what is happening in the regions above the Tropics.

FOR the first time in history "H" has been knocked out of matter by artificial means. The "H" in this case stands for hydrogen. The ejection of a proton, or hydrogen heart, from a collision between a heavy-weight hydrogen atomic heart and a carbon atom, reported by Professor E. O. Lawrence, of the University of California, is considered an important step forward in our knowledge of the constitution of matter and its relation to energy. Professor Lawrence, with his unique "merry-go-round" magnetic device for accelerating atomic projectiles, hurled some of the newly discovered double-weight hydrogen atoms at carbon of mass twelve. The carbon gained one unit of mass, or weight, and a hydrogen atom of ordinary weight was expelled in the form of a proton. One and a half million volts was fed into this synthesis and seven and a half million volts were emitted, which is a large release of energy. About two decades ago Lord Rutherford, in England, was the first to perform an atomic synthesis and knock "H" out of matter. He used the streams of helium atomic hearts, or alpha particles, that are released in the radioactivity of radium and other elements. Professor Lawrence's success in performing synthetic transmutation of a heavier element out of a lighter one with significant release of energy is an important new development.

NEW successes in a new method of element transmutation were announced by Dr. J. D. Cockcroft, from the Cavendish Laboratory, at Cambridge. The idea that atomic particles have wave-like properties and can force themselves into the hearts of atoms led to atom smashing that released very large amounts of energy. Lord Rutherford's first transmutations two decades ago were atom building without energy release. Dr. Cockcroft first turned lithium and a projected hydrogen heart into two helium atoms. Now he announced the disintegration of boron into three helium atoms, the breaking up of fluorine into oxygen and helium and the change of beryllium into lithium and helium when bombarded with hydrogen.

DR. THEODOR SVEDBERG, of Sweden, a recipient of a Nobel prize in chemistry, told how he had used the ultra-centrifuge, which is a scientific spinning top, to discover how many weights of proteins there are in blood serum. A few drops of blood and other complex substances, such as dyes, carbohydrates and hydrocarbons, whirled with 300,000 times the force of gravity, are separated, although the kinds of materials in them are extremely close to being the same weight. Dr. Svedberg photographs the substances while they revolve at high speeds. Living organisms can survive the terrific pull upon them in an ultra-whirling top, a force nearly three million times that to which our bodies are subjected by the ordinary force of gravity, as shown by experiments made at Stanford University.

EXPLANATION for the long-known but little understood tendency of wild plants to "sport" new varieties freely when introduced into cultivation, which they rarely or never do so long as they are in the natural state, was advanced before the botanists by Sir Daniel Hall, director of the John Innes Horticultural Institution. An earlier theory, accepted by Charles Darwin, held that plants were somehow encouraged to produce these new varieties by the better nourishment and care they got under cultivation. This theory made environment dominant over heredity. Sir Daniel held that the true explanation is to be sought elsewhere. Many, perhaps all, wild species bear within their germ-cells some of these varying traits, but they are "recessive" characters and are masked by their corresponding "dominants," also present. Whenever, by any thousand-to-one chance, a seed is formed that might produce a variant plant if it grew, the chances are still heavily against its reaching full growth; for in nature hundreds or even thousands of seeds are scattered for every one that grows. Furthermore, the chances are always that a new departure will have less "survival value" in the evolutionary struggle than the old, conservative original pattern, which has proved its worth against stern competition. So in the natural plant population the recessives stay buried. But when a gardener brings a wild species into his breeding ground, he first eliminates the chances against the seeds. Instead of only one in a thousand being allowed to reach maturity, something like nine hundred in a thousand are encouraged to grow. Thus the chance recessive combinations have an opportunity to come out and be seen. If they happen to be something that the gardener thinks is valuable—new color in the petals, new flavor in the fruit—he will single them out and inbreed them, preventing the re-masking by dominant characters that would be their fate in the cross-breeding of the wild state. Moreover, the gardener is not concerned at all with the natural "survival value" of an emerging character. He will shield the most ill-adapted plant, against all competition and enemies, if it has something he wants. If he happens to be a scientist rather than a commercial gardener, he will help even the most crippled and misfit plants to breed, should they promise biological information. In this combination of the encouragement of all seeds to develop to full growth, and the discouragement of re-immersion in the type and the checking of the ruthless course of natural selection, human choice gives the "recessives" repressed in nature their opportunity to express themselves. This does not preclude the arising of wholly new "mutations" in the cultivated stock, which were not present in the germ-plasm of the wild plants. These brand-new variations also occur, especially when encouraged to do so by such modern artificial means as x-raying or radium treatment. But these new mutations are much rarer than the segregation of the recessive characters that were always there but never had a chance.

DEATH is a great parting, not only between him who dies and his friends, but between the most intimately united parts of the microscopic cells of the body. When death comes, the constituents of the protoplasm part company. How this is seen in the dying cells of plants was described by Dr. Jean Dufrénoy, of the Plant Pathology Station at Brive, France. Living protoplasm, Dr. Dufrénoy said, is smooth, uniform, without even ultramicroscopically visible markings. As it streams around the cell, the only way its progress can be marked is by watching certain foreign bodies included in it, such as crystals and oil droplets. These show its movements as chips on the surface and loose pebbles on the bottom show the current of a crystal-clear brook. But when death comes, all is changed. The flow of the protoplasm slows down and stops, and the highest powers of the microscope disclose the appearance of numberless granules—the sure sign that the once uniformly assimilated substance has broken down and separated into distinct and unlike parts. While a cell is living, Dr. Dufrénoy continued, all its vital activities are carried on at the various surfaces of its protoplasm, where they front on its sap cavity, oil droplets, etc. Its chemistry is all surface chemistry. An outstanding exchange, indispensable to the continued life of the cell, is the taking up of oxygen and the voiding of carbon dioxide. The more active the cell, the more surface it exposes for this and other chemical exchanges, by throwing out extra folds and filaments of its protoplasm. But there can be too much of a good thing, in plants as well as in human beings and animals. Dr. Dufrénoy described a condition seen in the cells of plants afflicted with certain diseases, where there is an excessive development of these oxygen-exchanging protoplasmic surfaces. An examination of the respiration of such plants shows it to be much in excess of that of healthy plants: the sick plants are suffering from a real fever.

TWENTY thousand pairs of photographs were taken at the University of Chicago to show what occurs when an atomic nucleus is disintegrated when it is struck by a neutron—an atom of zero atomic number and zero electrical charge. So Professor William D. Harkins told the American Physical Society. Among the results of this long research, Professor Harkins enumerated the following: The slowest neutron which disintegrated an atomic nucleus had a velocity of 11,000 miles per second. The highest velocity for any neutron was found to be 35,000 miles per second, or about one fifth the velocity of light. This is an extremely great velocity for a particle of the mass of an atom. The energy of this neutron was extremely high, 16,000,000 electron volts, or very much higher than could be obtained by any artificial means now known. The mean velocity of the neutrons which disintegrated nitrogen nuclei was found to correspond to a temperature of 46 billion degrees. Such a temperature is not attained except possibly in the interior of a star. Since nothing is known by astronomers about the temperature of the interior of a star, except that it is very high, anything may be assumed. The nuclei of nitrogen atoms were found to disintegrate relatively often, while those of carbon and neon are very much more difficult to disintegrate. Evidence was obtained that the neutron, when it causes the disintegration of an atom is itself captured by the nucleus of the atom, but no good evidence was obtained to show that any disintegration can occur if the neutron is not captured. It was found that when an atom is disintegrated by the impact of a neutron, energy disappears, and gamma-rays, a very penetrating form of radiation, much more penetrating than x-rays, are given off. A new apparatus has been built for the photography of atomic disintegrations or syntheses. During the last day of operation this apparatus gave 6,400 pairs of photographs of excellent quality. Two motion picture machines are used to take the photographs, and to aid in the mathematical analysis of the photographs. Professor Harkins has suggested the name Neuton for this new element made up of all of the free neutrons in the universe. This is in many ways the most remarkable of all of the elements, since it is as different from all the others as the number zero is different from all positive whole numbers.

BRIGHT light "cures" nerve tissue poisoned with carbon monoxide in much the same manner that oxygen revives nerve tissue asphyxiated by oxygen starvation. This was announced by Professor Herbert Gasser, of Cornell University Medical College. When a nerve is stimulated it develops a sudden high charge or potential of electricity which comes and passes in a few thousandths of a second. This is followed by a longer period of milder electrification called the "after-potential." This potential can be diminished by various types of poisoning including carbon monoxide and asphyxiation. The after-potential is not only restored to normal but is raised above the usual level by the light or oxygen "cures."