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GENES AND CHROMOSOMES

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GENES, the tantalizingly elusive minute units that control our inheritance of such things as hair color and the shape of our noses, have been tracked down almost to their final lair by a scientific team consisting of an American, Professor H. J. Muller, of the University of Texas, and a Russian, Dr. A. A. Prokofyeva, of the Soviet Academy of Sciences' Institute of Genetics.

Professor Muller, on leave of absence, has been, during the past year, a research guest of the academy at Leningrad. The results which he and his colleague have attained to date were reported before the first meeting of the academy held at its new headquarters in Moscow.

Professor Muller and Dr. Prokofyeva have dealt with chromosomes, the minute sausage-shaped bits of living substances within the cell nucleus or center. These chromosomes have been regarded for many years as the abode of the genes although the exact distribution of the genes within them has never been accurately determined.

Now one of the outstanding results of the Muller-Prokofyeva research has been to trace known gene groups to definite locations within the chromosomes. They have made a much more exact map of their places of residence than has hitherto been possible. They have traced home to individual chromomeres the particular genes they singled out for study. Chromomeres are subdivisions of a chromosome only about one hundredth the size of the larger bodies.

The smallest bit of chromosome stuff with which Dr. Prokofyeva has worked had a diameter about equal to the shortest wave-length of visible light, which is sixteen millionths of an inch. Yet in or on that tiny particle there was room for several genes.

The two investigators hope that before long, they may be able to break off chromosome particles so small that they can contain only one gene apiece, and thus obtain a definite measure of the size of the individual gene.

The new attack on the secret of the chromosomes was made possible by two previous developments. First, by a method of inducing mutations or evolutionary changes in organisms through bombardment with x-rays, developed by Professor Muller some years ago. Second, by a new technique in staining chromosomes and mapping the gene locations on them, which was announced for the first time in December, 1933, by Professor Muller's colleague at the University of Texas, Professor T. S. Painter.

By bombarding the chromosomes with x-rays, and then studying the breaks and shifts in their minute structure thus caused, Dr. Prokofyeva was able to make a map showing where gene changes should be expected. At the same time, Professor Muller prepared another map, on a purely genetic basis, showing the locations of the gene changes. When the two maps were compared, they were found to correspond exactly, constituting a very nice case of mutual scientific support.

Sometimes the x-ray bombardment resulted in the dislodgment of a bit of chromosome carrying a few genes, which found its way to an entirely new place on the line-up and worked its way in, like a bird chased off a telegraph wire by a small boy's stone wedging itself into another roosting place without dislodging any of the crowded birds already there. Such newly-located chromosome fragments carry their genes into places where the interaction between the transferred genes and those already in place produce marked changes or mutations in the appearance of the resulting organism. The effect of a gene or gene-group thus appears to depend at least partly on is interaction with its neighbors, and not altogether on intrinsically possessed powers of its own. This "position effect" is a discovery that may be of very great importance.

Another result pointed out by Professor Muller is that in some cases it is possible for certain genes to become totally removed from the chromosome material without such loss killing the individual. Such "gene-deficient" individuals, however, do show abnormalities which may resemble the effects produced by mutations of the same genes.

Further research by Professor Muller and Dr. Prokofyeva is being pushed ahead energetically and full publication of the technical details of their work will eventually be made in both Russian and English.

SERUM FOR UNDULANT FEVER

TWENTY undulant fever patients quickly restored to health and normal activity by the use of a new serum constitute a record reported by a group of Cincinnati investigators to the American Society of Tropical Medicine meeting at San Antonio on November 14.

The serum was produced from goats after inoculating them with chemically treated suspensions of the organisms or "germs" that cause the disease. Drs. W. B. Wherry, A. E. O'Neil and Lee Foshay, of the University of Cincinnati College of Medicine and the Cincinnati General Hospital, are the group responsible for this advance in the fight against undulant fever.

The disease is a serious, long-drawn-out affair which may end fatally. It is caused by an organism known by various names, *Bacterium melitensis* being a correct technical title. Neuralgic pains, swelling of the joints, recurring attacks of fever, weakness and anemia are unpleasant features, and particularly unfortunate for the sufferer is the tendency for the disease to become chronic with frequent relapses and slow recovery.

Goats, cows and pigs suffer from the disease, and it is from these animals, particularly from unpasteurized milk of the first two, that man contracts undulant fever. The relation between the animal disease and the human disease and the value of pasteurization of milk as a preventive measure were established by Alice Evans, of the U. S. Public Health Service. In the course of her research she herself suffered a severe attack of the disease.

Treatment of undulant fever has remained unsatisfactory until the development of the anti-serum. So far the serum has been given to only twenty-six patients. But the results, according to Dr. Foshay, in over two thirds of the cases have been "extremely gratifying" and the lack of success in six cases was partly due, he believes, to the fact that in the first cases the serum used was not strong enough or not given in large enough doses or given too late in the course of the disease. To be successful, it is important that the serum be given before the end of the fourth month of the illness. Delay in starting anti-serum treatment was responsible for some of the failures.

In the twenty patients who were benefitted by the serum, the fever stage was reduced from the usual weeks-long period to an average of only nine days. Other symptoms disappeared within from one to six weeks, with an average of fifteen days. The patients were able to resume their customary activities in from eight days to two months, with an average of three weeks. They have been free from relapse for periods ranging from four months to twenty-nine months, or over two years. The success with this serum has encouraged the scientists to try to produce from the horse a more powerful and reliable anti-serum.

BALLOONS TO STUDY HIGHER ATMOSPHERE DURING STORM

STRATOSPHERE-SEEKING balloons, going up to study atmospheric conditions 15 miles above the earth, will court stormy weather instead of avoiding it, when the second mass flight launched by the Massachusetts Institute of Technology takes off from Lambert Field airport at St. Louis, Mo., in the near future. They will wait for word of an approaching storm area, and then hop off.

It is expected that every balloon in the flight will be wrecked; indeed it is even arranged that they shall burst. But there will be no human casualties. The 35 big gas bubbles in rubber will all be pilotless. They will carry only feather-weight meteorographs, which are instruments that automatically record temperature, humidity and air pressure.

When released, the balloons will not be fully inflated, to allow for expansion as they mount toward the 15-mile altitude they are designed to attain. Finally, when the thin rubber can stretch no farther, the balloons will burst. The meteorographs will then float downward on parachutes, and the slight shock of their landing will be broken by the light cages of split bamboo in which they are enclosed.

Attached to each meteorograph is a label announcing a reward for its return to Professor C.-G. A. Rossby, of the Massachusetts Institute of Technology. Professor Rossby states that of the 38 meteorographs sent aloft on the first mass flight last February, all but two were safely returned, their valuable records intact.

The mid-continental launching point at St. Louis was chosen, rather than the campus of the institute itself, because of the general drift of the atmosphere from northwest to southeast, it is explained. Balloons launched at St. Louis last winter fell in southern Illinois; if launched at Boston the chances are they would have fallen at sea and been lost.

DAILY VARIATION IN COSMIC RAYS

By Science Service

RESULTS of three years of research at the University of Innsbruck show that there is a daily, regular variation in the intensity of the cosmic rays striking the earth. Over 18,000 measurements have been made. The effect has been suspected but never proved conclusively. Dr. Victor F. Hess, working with Drs. R. Steinmaurer and H. Graziadei, of the university, will shortly announce to the Vienna Academy of Science that measurements in their cosmic ray meters indicate a daily fluctuation in intensity. The maximum occurs at midday, the minimum between 9 P. M. to 3 A. M. at night. The cosmic ray station at Innsbruck has been taking cosmic ray measurements continuously since September 1, 1931. Some of the apparatus has never stopped during that time. The station is high in the Tyrol Mountains at an altitude of 2,300 meters above sea-level, or well over 7,600 feet. The research program is part of the present world-wide plan to study cosmic rays.

That cosmic rays varied in intensity throughout a single day has been suspected by scientists but never before proved. Reporting in a preliminary announcement to the German scientific journal *Forschungen und Fortschritte,* Dr. Hess states: "It is not to be wondered at that for a shorter series of cosmic ray measurements at lower altitudes the daily change was not noted."

While avoiding a dogmatic assertion that the sun affects cosmic ray intensity, Dr. Hess suggests it would not be surprising if the changes in the magnetic and electric fields surrounding the earth—changing as they do from day time to night—might alter the part of cosmic rays which is now known to consist of electrical particles.

HEAT-ABSORBING GLASS

SCIENCE has now produced glass which removes most of the heat rays in sunlight, yet passes almost all the visible part of the solar spectrum. Wide usefulness for the development is seen in skylights and windows in industrial plants of the south during the hottest months of the summer. In addition the new heat-absorbing glass is hailed in the field of air conditioning for in this case it keeps the "cold" in, by keeping warmth out.

How the new type glass absorbs heat rays, and how much, was described before the Optical Society of America at its nineteenth annual meeting at the National Bureau of Standards, Washington, D. C. Dr. Roger S. Estey, physicist of the Electrical Testing Laboratories, New York City, described the characteristics of the new glass.

Solar energy as it seeps through the atmosphere of the earth, Dr. Estey explained, has only about one third of its rays in the visible region of the spectrum. A total of 66 per cent. of sunlight consists of an invisible ultra-violet light on one side and the unseen infra-red, or heat, rays on the other. The heat-absorbing glass cuts down, markedly, the heat ray portion of the spectrum.

Small amounts of iron in the glass act as the "heat catchers." Some types of glass will stop and absorb 52 per cent. of the heat rays. Eight per cent. of the sunlight is reflected off the front surface of such glass. The remainder consists of the visible rays. While heat absorbed in the glass must be re-radiated, much of it can be carried away by the proper design of ventilation around the window or skylight. What remains after this process is radiated, half to the outside, and half inside. The part coming into the room is spread out in all directions. A person sitting in a beam of sunlight in the room feels little, if any, heating from the beam because his body subtends such a small angle compared with the solid angle of the room.

The development of the commercial use of heat-absorbing glass, according to Dr. Estey, came about because of research on heat-absorbing glass filters in motion picture projection machines, and because of the need for improving the shatter-proof windows in automobiles.

Shatter-proof windows are laminated glass "sandwiches" made of a layer of celluloid cemented between two layers of glass. Until recently sunlight turned the celluloid yellowish in color. In a study of how to prevent this phenomenon it was found the rays of sunlight had to be absorbed more strongly. When the problem was solved it was found a heat-absorbing glass had been developed.

REPTILES OF THE SOUTHWEST TWO HUNDRED MILLION YEARS AGO

REPTILES as big as St. Bernard dogs were plentiful along stream banks and swamp lands of the Southwest some 200,000,000 years ago. These animals probably bore some resemblance to the large lizards of to-day, but were more sluggish in movement. They were stockily built, with short legs and broad, flat feet. There were also smaller reptiles, some no bigger than a mouse.

This picture of the distant past is drawn by Dr. C. L. Camp, director of the museum of paleontology at the University of California, who has returned from New Mexico, where he and his assistants discovered large fossil deposits in a region about 75 miles from Santa Fé, in the Chama River country.

In a preliminary survey of these fossil beds some time ago, Dr. Camp found pockets in them which revealed new material. These pockets, he says, probably represent pools of water in which bones were deposited in clay. On the trip this summer, H. T. Anderson, member of Dr. Camp's party, found a pocket of this nature, which was about seventy feet long and thirty feet wide, containing fossils of animals that had lived there during the Permian geologic period, a long era of world-wide "hard times" that followed on the heels of the Coal Age, which represented an era of geological "prosperity."

It was here that Dr. Camp uncovered a large quantity of bones of primitive reptiles. One of the skulls found was of a reptile about the size of a small dog. Its teeth were cylindrical in shape, about 1½ inches long, and located at the front of the snout.

Some of the other smaller animals had button-like teeth on the roof of their mouths; others had short, chisel-like teeth; still another form had 24 long needle-like teeth in a jaw only two inches in length.

The most valuable of these specimens were "blocked up" in plaster of Paris. Some of these blocks weighed about 400 pounds. They had to be carried in a sling fashioned between two poles for a distance of half a mile to the waiting trucks. About 3,000 pounds of material was packed out in this manner. These specimens are now in the keeping of the University of California's museum of paleontology.

ITEMS

REINMUTH'S comet of 1928, first seen by Professor K. Reinmuth, of Heidelberg Observatory, on February 22, 1928, has been rediscovered by Dr. H. M. Jeffers, of Lick Observatory. This is the report of Dr. Harlow Shapley, director of Harvard College Observatory, which is the coordinating center for astronomical data. Between one and two o'clock Pacific Standard Time in the morning of November 5, Dr. Jeffers first caught sight of the diffuse, faintly glowing object north of the constellation of Orion, which at this hour is slightly southwest of the zenith overhead. Powerful instruments are needed to detect the faint object of the sixteenth magnitude of brightness.

ASTRONOMERS are now observing the little planet Hidalgo, which has come into view again through large telescopes after being invisible since 1925, the year following its discovery. Hidalgo is of interest because it looks like an asteroid, but moves like a comet. It is inclined to the ecliptic, the path of the sun through the sky, by some 37 degrees, more than that of any other asteroid, an amount which is not unusual for a comet. Hidalgo was rediscovered in August by W. R. Boyd, of the Harvard Observatory, and was recently picked up at the Simeis Observatory in Russia by Professor G. Neujmin. It is moving through the constellation of Pisces, high in the southwestern sky in the late evenings. As it is of the twelfth magnitude, it can be seen only through powerful telescopes.

FOSSILS of fern-like plants of very simple structure, with a great deal of branching stem but with nothing that can be surely identified as leaves, have been found in a deposit of Lower Ordovician limestone at Beartooth Butte, Wyo., by Dr. Erling Dorf, of Princeton University. Together with other similar fossils found in a very few scattered places over the earth, they belong to the oldest known groups of land plants, known to botanists as the order Psilophytales. The limestone mass in which they occurred in the Beartooth Butte formation contained evidences of having been formed where a broad-mouthed river met the sea. The fossils, which when they were living plants probably grew as a fringe of vegetation along the marshy shores, were intermingled with armor-plates from the skin of the primitive fishes of that remote time. Dr. Dorf collected the fossils with the assistance of a field party supported by the William Berryman Scott Research Fund of Princeton University. His technical description of the five species discovered has been published in *The Botanical Gazette*.