SCIENCE NEWS

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SUBDIVISIONS OF CHROMOSOMES

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DEMONSTRATION of structural details within the chromosomes, considered by most biologists to be the bearers of the "genes" that control the inheritance of physical and physiological characters in animals and plants, compares in importance with the demonstration a few years ago of the divisibility of the atom into smaller electrically charged particles. Like the atom, the chromosome was suspected of being made up of distinct functional units on theoretical grounds for some time before the scientists' "hunch" was proved to be correct.

Dr. Calvin B. Bridges, of the Carnegie Institution of Washington, carried on at the California Institute of Technology and lately in the genetics laboratories of the Carnegie Institution at Cold Spring Harbor, N. Y., researches which have made clearly visible the separate units of which the chromosome is composed.

A brilliant lead, to which Dr. Bridges acknowledges indebtedness, was developed during 1933 by Professor T. S. Painter, of the University of Texas. Professor Painter worked with the "giant" chromosomes found in the salivary gland cells of fruit-fly larvae, which are seventy times the size of ordinary chromosomes. He found on them numerous cross-bandings, which always had the same sizes and spacings on comparable chromosomes. He found also that with particular groups of these bands, groups of known genes could be correlated. This constituted the first truly quantitative, accurate gene-mapping ever accomplished.

When Dr. Bridges went to work, with Professor Painter's results before him, he strove first to penetrate the veil of the chromatin. He developed a technique which enabled him to see through it, to get at what was inside. The chromatin, it developed, was not the important part of the chromosome at all, but only the matrix, the outside wrapping. Now that the contents were visible, it could be seen that what Professor Painter had first described as bandings on the chromosomes were really the edges of solid disks that ran clear through the chromosomes, strung together like beads on a thread. It was seen also that each gene locus corresponded with some special size or shape of "bead," always in the same relative position and always the same in all chromosomes examined, just as they had been on the "bands" described by Professor Painter. "As easily located as the houses on Main Street in the Old Home Town," is the vivid and homely characterization given by Dr. Bridges to the genes' places in the chromosomes.

But that was not the whole story. Not even the units of the now transparent chromosomes were the last words. They proved to be subdivisible also. Each disk is made up a bundle of tiny rods, like a big handful of cigarettes; their ends are visible as dots on the faces of the disk. There is a continuity between these rods, from disk to disk; Dr. Bridges has likened them to segments of the strands in a twisted cable.

So small are these sub-units that many of them are hardly larger than a single molecule of one of the more complex proteins. They may, indeed, be single molecules, or they may be small groups of molecules acting together. Whether these tiny units are the genes themselves, or only the "genophores" or gene-bearers, is a matter of relative unimportance. The important thing is that they have now been unveiled, so that the searching finger of science may probe a little further into the secrets of life.

The principle milestones in the development of modern genetics may be listed as four: Gregor Mendel's proof, three generations ago, that genetic units determine the inheritance of characters; Otto Bütschli's demonstration of the existence of chromosomes; Thomas Hunt Morgan's concept of the gene; Painter and Bridges's separation of the chromosome into its finer structural units and their correlation with the location of the genes.

ELECTRICAL CHARGES ON BACTERIA

BY studying tiny electrical charges on bacteria, so minute that they can be measured only with difficulty, medical science is learning what brings about reactions between disease organisms and the body tissues. In particular, the rôle of "germ electricity" in bringing about the process of agglutination, by which the body fights disease, is being made known. Agglutination is the technical term for a clustering or clumping of bacteria under certain conditions which reduces their mobility and activity in the body.

In a report presented before the Electrochemical Society meeting in New York, Dr. Harold A. Abramson, associate in bacteriology at Cornell Medical School, described the small electrical charges which exist on bacteria and all microscopic particles when immersed in a water solution. Such electricity is not a specific property of bacteria alone but is present also on blood cells, fungus cells, yeast cells and even such inert things as quartz dust and oil droplets when they are immersed in an aqueous solution.

It was the existence of tiny electrical charges on oil droplets, when sprayed from an atomizer, that enabled Dr. Robert A. Millikan, of California Institute of Technology, to measure the fundamental unit of electrical charge—the much-talked-about electron. While Dr. Millikan is now best known to the public for his researches on cosmic rays, he received his greatest award—the Nobel prize in physics—for his work on measuring the charge of the electron.

Dr. Abramson, using a method somewhat similar to that which Dr. Millikan employed, studies the charges on bacteria. Instead of the charged particles being in air, however, they float in a solution. Their rise and fall, under the influence of an electric field from two plates immersed in the solution, enables him to study the tiny electric charge present.

In an interview Dr. Abramson indicated that the viru-

lent and avirulent forms of the organism causing diphtheria can be distinguished by the electric charges they possess. Certain forms of streptococcus organisms can likewise be distinguished, and it is now possible to classify the different types of organisms which cause pneumonia by the same electrical method.

In his report to the society, Dr. Abramson told how estimates were made, for the first time, of the amount of electricity on a typical microscopic organism like colon bacillus or typhoid bacillus. These disease organisms are so small that about 240,000,000 of them would not occupy more than a square inch. His calculations reveal that only about 300,000 electrons form the electrical charge on each organism.

While 300,000 electrons sound like a large amount of electricity, the electron is a very small unit. Every second an electric light in the home burns, it is using electrons by the millions and billions. So minute is the amount of electricity that despite the extreme small size of the bacteria the electrical charge occupies only about one per cent. of the area.

In a study of the surface electricity of organisms Dr. Abramson found that when agglutination occurs there is still electricity present. Previously held theories indicated that when the bacteria came together in agglutination the electric charge on the surfaces was neutralized and lost. The study of surface electricity on bacteria is important, Dr. Abramson said, because the organisms are so small it is hard to measure anything about them. Accurate determination of the electric charge is one of the few ways they may be studied.

SIZE OF THE GALAXY

(*By Science Service*)

THE starry galaxy or Milky Way universe in which we live is only half as large as astronomers have supposed hitherto. Shrinking by half the distances of the stars from the earth, latest researches at the University of Wisconsin by Professor Joel Stebbins and his assistant, Professor C. M. Huffer, reduce our "island universe" to about the size of the other galaxies that are found scattered about at great distances in the heavens. Thus once more the part of the universe near us is proved not to be unique.

The astronomical "electric eye" was turned upon 733 stars so hot that they appear bluish in the heavens. All were in the Milky Way. The electric eye measures to a thousand-million-millionth of an ampere the energy sent to earth by stars. With this instrument, which contains photoelectric cell and amplifying vacuum tubes, Professors Stebbins and Huffer confirmed the presence in the Milky Way of a thin layer of dark scattering material which they call dust particles, whose interfering effect has dimmed the starlight and caused astronomers in the past to judge the stars about twice as far away as they really are.

The blue-hot stars, with temperatures of 20,000 to 30,000 degrees Centigrade, three to six times the sun's temperature, have a reddish hue, and this grows more intense the closer they are to the Milky Way's center. This reddish color is caused by a thin stratum of absorbing material near the Milky Way. This layer is believed to be similar to the dark lanes that we see in other galaxies viewed edge on.

THE HEAT OF SOUND

AT the Massachusetts Institute of Technology there has been devised new and more accurate methods of determining the heat of sound. Instead of measuring sound variations in terms of air pressure as does a microphone, the new sound thermometer records the alternating temperatures produced by sound waves traveling in air.

The device was developed at the Round Hill estate of Colonel Edward H. R. Green, M. I. T. research station near South Dartmouth, Mass., by Ellis A. Johnson, of the institute under the direction of Professor Richard D. Fay and Professor Louis Harris.

The sound thermometer is essentially an exceptionally delicate thermocouple comprising thin metal strips of dissimilar metals, bismuth and antimony for example. Each strip is but .00001 centimeter in thickness and is mounted on cellulose acetate films of the same thickness. Together the film and strip are mounted on a thin mica frame.

The thinness of the metal strips may be appreciated when it is realized that a million of them together would make a pile not much more than an inch thick. The amplifier used to "step up" the tiny electrical current generated at the junction of the two dissimilar strips of metal by the heat of sound, is capable of responding to one one-hundred-millionth of a volt.

The thin metal strips or films are so delicate that they do not disturb the sound field they are measuring as do other devices. The sound thermocouple with its amplifier is about 100 times more sensitive than previous couples. It is capable not only of recording the minute variations in temperature produced by sound waves but of recording these variations when they are occurring at many thousands of times each second.

Already the new device has been used to measure the adiabatic heat produced in a sound field up to frequencies of 10,000 cycles a second, and its range can be extended to 300,000 cycles.

The delicacy of the thermocouple makes it an excellent instrument for measuring sound which the ear can not hear, and it is adapted also for light measurements.

COOPERATION OF SCIENCE AND THE PRESS

A STRONG plea for cooperation between science and the press in Great Britain along the lines of Science Service in America was voiced by Sir Richard Gregory, Bart., editor of *Nature*, in his presidential address before the Association of Special Libraries and Information Bureaux meeting at Oxford on September 21.

Stating that "most admirable work for science publicity has been carried on in the United States since 1921 by Science Service," Sir Richard said that "it would be to the advantage of science and the newspaper press if similar organizations for science publicity were established in other countries and cooperated with one another in an international science agency."

"Art and letters, music and religion, have their interpreters in the periodical press and can not complain of any lack of attention to their works or teaching," Sir Richard said. "In its human interests, science can make just as wide an appeal as any of these, but there are few who can review scientific matters with the independent and critical mind which estimates the value of opinions or performances in other spheres. A bare announcement of a scientific discovery may be worth publication as an item of news, but not much more so than a report that an important creative work has been completed by an eminent artist or man of letters. Supplementary to such news, reasons must be given why the discovery or work is of particular significance; which means that its characteristics must be clearly described by a competent writer."

"It is surely the duty of the press," Sir Richard declared in his concluding remarks, "as a service of public utility and the man of science as a citizen as well as a discoverer, to affect a rapproachement in order to create a public opinion which will ensure that no advantage may be lost which might accrue from the application of the results of scientific research to the needs and amenities of daily life. A more intelligent and more intelligible consideration of scientific work and thought is desirable in the public press because of their close contacts with many national and international problems. Under the conditions of modern civilization, the community in general is dependent upon science for its continued progress and prosperity. Under the influence of modern scientific discoveries and their applications, not only in industry, but also in many other directions, the whole basis of society is rapidly becoming scientific; and to an increasing extent, the problems which confront the national administration involve factors which will require scientific knowledge for their solution.

"It is in these directions that the press can render the greatest service to science and the public at the same time. Under the present social and educational system, it is not possible to hope that at any very early date our schools will turn out a population of scientifically-trained men and women. But it is becoming recognized, though slowly too, that what is needed is not so much detailed or expert knowledge of science, as the scientific outlook. The function of the press, more readily to be appreciated perhaps when something of this scientific spirit has been inculcated in the schools, might very well be, by fostering this outlook, to ensure that the problems of government and administration of society and of economics, are approached with scientific understanding."

ITEMS

THE first atomic weight determination of proactinium, next to the heaviest element, have been made by Professor Aristid Von Grosse and M. S. Agruss, of the University of Chicago, who recently isolated this element for the first time. The value of its atomic weight is 231 with an accuracy of 0.5 per cent.. Announcing results to the inorganic group of the Chicago section of the American Chemical Society, it was explained that the one tenth gram of proactinium oxide recently isolated was used for that purpose. The pure compound potassium proactinium fluoride was prepared and converted into the oxide, using platinum equipment exclusively. The ratio of two molecules was determined by means of a sensitive ultra-micro-balance. From this ratio the value of the atomic weight was determined. This atomic weight fixes also the values of all other elements of the actinium radioactive series and is in complete agreement with the result of Professor F. W. Aston, on actinium lead obtained with his mass spectrograph.

STARS so intensely hot that most of their radiation is in the invisible ultra-violet region, "cool" yellowish stars like our own sun, and the relatively chilly red stars like the giant Antares, have all had their temperatures taken by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, and Dr. Joel Stebbins, director of Washburn Observatory at the University of Wisconsin, who worked together during the past summer at Mount Wilson, Calif. Using in combination a set of filters that pass only certain colors, or bands of wave-lengths in the stars' radiation, and an exceedingly sensitive photocell devised by Dr. Stebbins, the two scientists "took apart" starlight from stars many light-years distant from our own solar system, and measured the amount of energy in each constituent part.

THORIUM and uranium, heavy elements continually breaking down in nature's process of radioactive disintegration, are now used by industry. New photoelectric cells for studying ultra-violet radiation in that region of light which produces sunburn employ uranium, while thorium is placed in many types of vacuum tubes. These little known practical applications of thorium and uranium were described before a recent meeting of the Electrochemical Society by J. W. Marden, of the Westinghouse Lamp Company. When a layer of thorium only a single atom thick is coated on a tungsten filament in a lamp the lamp filament increases its emission of electrons. Where an increased electron emission in a specific tube is desired the thorium coating is sometimes the answer to the problem. Uranium, sensitive to light, is used in photoelectric cells where science needs an instrument to study the intensity of the invisible ultra-violet rays.

SOMETHING besides the tuberculosis bacillus is responsible for tuberculosis. This was the consensus of opinion of tuberculosis experts who discussed the question at the recent meeting of the American Hospital Association. The discussion was opened by Dr. C. H. Sprague, of Broadlawns Polk County Public Hospital, Des Moines, Iowa. Dr. Sprague pointed out and other physicians corroborated him that cases of tuberculosis have decreased unexpectedly during the period of economic depression. This led him and other tuberculosis workers to wonder whether the factors of good food, good homes, fresh air and cleanliness were of such importance in preventing tuberculosis as has been supposed. Examination of all children in order to detect possible cases of tuberculosis was universally accepted as a measure of prime importance in fighting the disease.