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THE FIFTH INTERNATIONAL BOTANICAL CONGRESS

AMERICAN leaders in the study of plant life were accorded prominent places in the councils of the Fifth International Botanical Congress, which assembled at Cambridge on August 16. The presidency of the meeting was naturally given to the great university which is acting as host to the world botanists, in the person of Professor A. C. Seward. But the active work of the sessions is carried on in eight sections, and three of the eight section chairmanships have been assigned to American scientists. These are Professor H. C. Cowles, of the University of Chicago, who presides over the section on plant geography and ecology; Professor R. E. Buchanan, of the Iowa State College, at Ames, who has charge of the section on bacteriology, and Professor L. R. Jones, of the University of Wisconsin, whose section deals with questions of plant diseases and the fungi that cause them. There are also three Americans in the list of honorary vice-presidents of the congress: Professor L. H. Bailey, of Cornell University; Professor R. A. Harper, of Columbia University, and Dr. E. D. Merrill, of the New York Botanical Garden. American botanists are turning out in large numbers for this meeting, the first international gathering of its kind since the International Congress of Plant Sciences held at Cornell University, Ithaca, New York, four years ago. The Ithaca congress was the first international botanical meeting of the post-war period. Over three hundred American botanists had signified their intention of attending the present congress.

ACCORDING to advance reports, Professor A. C. Seward, of Cambridge University, president of the congress, told of the difficulties in bridging the gap between the plant forms of the late Paleozoic, when the principal coal beds were formed, and those of the Mesozoic, or age of dinosaurs. World climate, and the face of the earth itself, underwent revolutionary changes during that critical period in geological history, according to Professor Seward, and the great changes in environmental conditions were reflected in the downfall of the earlier dynasties that had ruled the ancient forests and the rise of new and different dominating families. The hereditary steps by which the new arose from the old can not be traced in any fossil records which have yet been discovered. Professor Seward believes that the rocks of inner Asia, which have recently given up many of the early family secrets of the dinosaurs, may also yield some of the missing chapters in the story of plant evolution, once they are searched with sufficient care and understanding by men who can tell when and where there was a forest a hundred thousand years ago by searching for microscopic grains of fossil pollen in the peat of an ancient bog. The yellow fertilizing dust that settled on the waters and was drowned and absorbed into the muck on the bottom is read especially zealously to learn the movements of the great thickets of hazel that marched on the margins of the sub-arctic forests in the days when the glaciers were retreating from the face of Europe. But it is not all plain sailing, this seeing of woods where only the fossil dust of its flowers remains. According to Dr. G. Erdtman, of the University of Alberta, there are difficulties in searching for vanished woods with a microscope. It can not be assumed that where there is much pollen there was a heavy growth of the plants that produced it, and that where there is none there were few or no such plants. If the bog into which the pollen fell was not in proper condition to receive and preserve it, the pollen would be lost and thus no record would remain. Such conditions would include a chemical or bacterial state of the water that would cause the pollen grains to decay, a frozen surface over the bog at the time of pollen-shedding, or one of a number of other circumstances. Therefore one's grain of pollen must sometimes be taken with a grain of salt.

MODERN Denmark is a country of man-made forests. Only about eight per cent. of its territory is wooded, and about two thirds of that fraction consists of evergreens planted by man—wholly artificial forests. The remaining third consists of almost pure stands of beech. These were originally native forests of mixed timber, but due to selective cutting almost nothing but beech is left. The problems of forestry in an almost forestless country were presented by Professor C. H. Ostenfeld, of the University of Copenhagen. Danish foresters do not really like the pure beech forests, for beech trees are exhausting to the soil, and are not such valuable timber as some of the trees they have replaced in the course of the centuries. However, the highly valuable oaks were all cut out many years ago, and the beeches did not permit them, nor any of the other hardwood species that went with them, to develop again. Beeches form a dense shade, beneath which their own seedlings can grow, but not the seedlings of other trees. The shade is so dense, in fact, that very few bushes and herbs will grow in a beech forest. The return of a mixed hardwood forest, of a type resembling the original native woods, is much desired by Danish foresters, but they have to foster it by strictly artificial means.

EVOLUTION through crossing of dissimilar parents, a rival theory to the continuous-variation idea of Darwin and the sudden-mutation mode advocated by DeVries, is upheld by a Dutch botanist, Dr. J. P. Lotsy. He points out that our idea of a species is based on the assumption that all individuals that look very much alike have had a common descent. We see the grandchildren and take the ancestors for granted. Beginning at the other end, he selects ancestor-plants and traces the development of new character-combinations in their descendants. In spite of the plausibility of the mutation theory, he insists that it has never been proved that a new form of specific rank has arisen in this manner. The only new forms whose origin has been actually observed have been produced by hybridization, though even these are not of specific rank. Dr. Lotsy regards it as quite possible that the main divisions of the organic kingdom originated by hybridization. In many of the lower forms of life, from which the higher ones are assumed to be derived, the cell protoplasm as well as the nuclei unite during the reproductive process. This, Dr. Lotsy states, furnishes a possible mechanism for the development of the major differences that separate the great divisions of the plant and animal kingdoms.

THE stem or leaf of a plant can best be understood if we think of it partly in terms of the engineering principles governing reinforced concrete structures, partly in terms of the principles governing flexing springs. The plant's mechanical problems demand a compromise between these two sets of principles, and the most successful plants are the ones that have evolved the best structural compromises. As a matter of fact, plants have on the whole been more successful as inventors of reinforced structures than have human engineers. These are the central ideas of an address by the Russian plant physiologist, Professor W. Rasdorsky. The classic theory of plant parts as mechanical structures regarded stems and similar parts merely as sets of rigid beams. They are much more like reinforced concrete pillars, the long tough strands, frequently interwoven with each other, representing the reinforcing rods or webs of expanded metal, the pith and small-celled tissues between the strands representing the concrete "fill," and the hard rind taking the place of the "armor" in which reinforced concrete columns are sometimes sheathed. Plants have an advantage over artificial reinforced structures because reinforcing strands and "fill" are grown together, not merely poured and tamped together, so that there is far less danger of cracking or ripping apart. Furthermore, the "fill" of small cells is much more elastic and compressible than is the mass of cement and crushed rock in a concrete pillar, so that there is a certain amount of "give" under a heavy strain, which might cause an overloaded completely rigid structure to buckle and break.

EVEN so minute a living thing as a bacterium parasitic on plants has an internal structure corresponding in a way to the various organs found in larger plants or animals. R. H. Stoughton, of the Rothamsted Experimental Station, England, has found that the germ of one of the serious diseases of the cotton plant, angular leaf-spot, which has been described as "structureless," has quite a number of special features about it that can be seen by sufficiently careful microscopic examination. Most important of the internal structures is a central mass that seems to correspond with the nucleus in the cells of higher organisms. It divides when the bacterium itself is preparing to split into two new individuals, which is one of the most characteristic of nuclear performances. Mr. Stoughton also observed individual bacteria budding off tiny round bodies, which subsequently "germinated" into the rod-like shapes of the parent organisms. Mr. Stoughton also experimented with cultures of the organism to find out under what conditions the disease was most likely to attack cotton plants. He worked with apparatus designed to control air temperature, soil temperature, air humidity and light. With these environmental elements under control, he found that the bacterium likes a temperature of 75 degrees Fahrenheit best, and will not grow if the mercury rises above 94 degrees. If a liquid containing the bacteria is sprayed over the leaves of the cotton plant, infection will occur at all temperatures up to 104 degrees, but there is some evidence that younger leaves are most susceptible at low temperatures and older ones at high.

IF you were a physician, what would you make of a disease germ that changed its trade almost overnight, and thereafter produced some other kind of a disease? That is one of the diagnostic difficulties that plant pathologists are up against as shown by studies by J. Henderson Smith, of the Rothamsted Experimental Station, England. The only way one can be quite sure of his diagnosis of a plant disease caused by a filterable virus is to have a pedigreed culture of the virus and a standardized host plant of known source, age and environment. Under unstandardized conditions, such as one has to deal with in the field, the symptoms of the various virus diseases differ so much as to make identification by inspection alone untrustworthy. Even a difference in the mode of infection may make a considerable difference in the appearance of the disease. The most baffling difficulty encountered in some cases, however, is the tendency of the viruses themselves to change, especially when the disease has been transferred from one plant to another of a different species or variety. These changes in some instances seem to be permanent. The virus diseases with which Mr. Smith has been dealing are caused by organisms (if they are organisms) too small to be seen with even the highest powers of the microscope. Whatever the causal bodies may be, they can pass through the pores of a fine-grained porcelain filter; whence their name, filterable viruses.

BACTERIA that find oxygen a poison and that breathe hydrogen instead have had their physiological secrets investigated by Professor J. W. McLeod, of the University of Leeds School of Medicine. Plants and animals take up oxygen simply as the readiest means of obtaining energy from food substances. These bacteria, which prefer places where there is little or no air, are able to get their needed energy by a different process. They detach hydrogen from certain complex organic compounds, and the breaking apart of these molecules releases energy. Oxygen is inimical to this process. If the newly released hydrogen comes into contact with oxygen the two elements unite to form hydrogen peroxide. Bacteria that can live in the presence of a very little air can tolerate a certain low concentration of hydrogen peroxide, but those that demand surroundings where there is no oxygen at all apparently find themselves paralyzed if hydrogen peroxide is generated even in small quantities. A curious fact about these oxygen-hating bacteria is that they are quite lacking in one of the enzymes or organic ferments, catalase. This particular enzyme was once thought to be absolutely indispensable to any kind of life.

THE root bacteria of clover, alfalfa and other legumes, that befriend the plants and through them man and his domestic animals, come at the outset as though they were enemies. They invade the delicate, thin-walled root-hairs in just about the same way as disease germs, and cause them to curl up as though they were sick. These are among the things that were seen by Dr. H. G. Thornton, of the Rothamsted Experimental Station, England, and Dr. E. F. McCoy, of the University of Wisconsin. Not all the roots of a susceptible plant can be invaded by the bacteria. Alfalfa seedlings were suspended with their roots in a thick "soup" of nodule bacteria; yet only about four per cent. of the root-hairs received bacterial guests. Moreover, the plants seemed to have a considerable degree of resistance to such invasion during their infancy, for no bacteria found their way through the walls of the root-hairs until the seedlings had put forth their first true leaves. This would seem to indicate that a secretion of the roots was active, either in discouraging the bacteria before the leaves appeared, or in encouraging them when the proper time arrived.

WHATEVER believers in the permanence and unchangeability of species may have to say about higher plants, they must speak softly when they deal with the lowly moulds. Evolution while you wait seems to be the order of the day with some of them. Dr. William B. Brierly, of the Rothamsted Experimental Station, has worked with cultures of *Botrytis cinerea*, a common fungus found on grapes. This organism simply will not "stay put," he has discovered. Starting with a single spore, to make sure he had as uniform a stock as could be secured by any known method, he found that the offspring organism varies constantly. Some of the variations were discontinuous, some progressed continuously. He could induce a continuous modification at will by varying the culture medium and return it to the original type by restoring original environmental conditions. But some of the discontinuous variants refused to revert to type even under prolonged selection.

SULFUR has a blighting and fatal effect on some of the fungi responsible for plant diseases. But to do its work a particle of the solid sulfur itself must come into contact with the thread-like body of the fungus. This has been discovered by Dr. William Goodwin, of South Eastern Agricultural College, Wye, England. His work was designed to settle the disputed question whether sulfur volatilized by heating could also kill fungi; he found that it could not. He also found that the effectiveness of powdered sulfur in washes and sprays is heightened by the presence of an alkali.

LIVING plant cells can be induced to absorb dyestuffs, making their usually invisible workings possible of examination with the microscope, according to Professor Hans Pfeiffer, of Bremen. Professor Pfeiffer sometimes encountered difficulties in getting living protoplasm to take up coloring matter rapidly enough, or evenly enough, or without damage to itself. He also planned to present a paper on the persistence in mature stems of cells that are essentially in a state of permanent infancy.

BOTANIZING through the forests of about a quarter of a billion years ago and comparing their floras as one would compare plants gathered only yesterday, Professor Dr. W. Gothan, curator of the Prussian Geological Institute, Berlin, has found notable similarities between the plants of England, of Schleswig in Germany, and of parts of Asia Minor. Plants of the same periods from remoter parts of the world, he found, were different from each other, just as plants from the far ends of the earth to-day are dissimilar. The differences are frequently so great that it is difficult to judge whether they were alive at approximately the same time. Nevertheless, one of his German colleagues has been able to find instructive parallels between fossil plants from Shansi province in China and others discovered by Dr. David White, of the U. S. Geological Survey, in the Grand Canyon of Arizona.

EVERY treetop lives in a desert, exposed to hot sun and drying wind; it is, moreover, farthest removed from the base of water supplies. It responds to these desert conditions by becoming more or less like a desert plant, Professor Bruno Huber, of the University of Freiburg, has discovered. An examination of leaves and stems from the tops of trees showed anatomical differences according to their location in sun or shade. "Shade leaves" were more like those on the parts of the tree closer to the ground and better sheltered from evaporation; "sun leaves" were protected in various ways from the drying effects of the air. Sometimes they worked to keep down the rate of evaporation by means of thicker skins, smaller cells, tinier breathing-pores or stomata, etc., and sometimes they yielded to the air's demand for water but had better facilities for renewing the supply from beneath. Professor Huber calls attention to the fact that plants of both types can sometimes be found growing side by side in places where the evaporation rate is high.

DR. H. S. THORNTON, of the Rothamsted Experimental Station, has found that entirely new types, in either shape or size, will appear in a culture of bacteria. They persist even when they are subcultured for many generations. They seem to be genuine cases of the evolution of new varieties taking place before our eyes. Dr. Thornton warned, however, against regarding as genuine new types strangers that have wandered into the culture. As against the old doctrine that bacteria reproduced only by breaking into two even halves, Dr. Thornton supports the new evidence that sometimes they bud off smaller pieces, which then grow up into full-sized bacteria.