SCIENCE NEWS

MAKING PLANTS TURN MORE SUNSHINE TO FOOD

Science Service

POSSIBILITIES of increasing the food supply of the world through study of agricultural factors as yet little understood are enormous, according to Sir John Russell, F.R.S., president of the agriculture section of the British Association for the Advancement of Science.

No attempt has been made in the field to control two of the most important of these factors influencing the growth of plants, light and temperature, although both now are subjects of experiment. He spoke of four possible fields of experimentation which hold out promises of increasing yield and quality many fold:

(1) Increase of plants in efficiency as transformers of the sun's energy. At present plants transform only about one per cent. of this energy. The most efficient plant lags far behind the worst motor car. If some means of utilizing two per cent., the amount of energy transformed by a steam engine 100 years ago, would be obtained it would make the average wheat crop in England 400 bushels per acre instead of the 200 obtained now. Sir John said that increases in plant growth amounting to from 20 to 25 per cent. have been obtained in England by the influence of high tension electrical discharge which presumably acts by increasing in some way the efficiency of the plant as an energy transformer. The value of experiments along this line, he said, lies in the great increase in yield obtainable by a small increase in efficiency.

(2) Adaptation of plants to both soil and climate. A soil moderately fertile under one set of climatic conditions may be absolutely unproductive in another. A clayish soil which in England is almost barren proves excellent grain and cotton land in the Sudan. Clay under wet conditions becomes a serious drawback. It might be possible, Sir John said, to find some mathematical relationship between rainfall and the degree of objectionableness in clay. The fertility of soil in any given locality is dependent to a considerable extent on the fact that it fits in with the climatic conditions in supplying the needs of the plant. To make the complexity worse the soil itself is not constant but is always varying within certain limits.

(3) Temporary changes in plants brought about by changed conditions, wholly independent of the plant breeder. It is a commonplace among farmers that certain soil conditions influence not only the yield but the quality of crops. At Rothamsted, England, the sugar content of mangold roots, an important factor in determining feeding value, was increased by increasing the supply of potassium to the crop. Grass has been increased in feeding value, quite apart from any increase in quantity, when treated with phosphates. At Rothamsted a high-class cook can distinguish between the quality of potatoes fertilized with potassium sulphate and those fertilized with potassium chloride. Grain, however, has proved more difficult to alter by changes in environmental conditions although the protein in wheat has been increased by increased soil moisture.

The Institute of Brewing in England now is making a full investigation of barley, still the basis for the national beverage. It has been found that increased moisture increases the amount of nitrogen in the grain and so also does an increased nitrogen supply, although to a much less extent. Other substances, such as both potassic and phosphatic fertilizers, may decrease the percentage of nitrogen, although they do not always do so. The laws regulating these changes still are unknown, Sir John said.

(4) Control of pests or parasitic diseases, which in England ruin at least 10 per cent. of the total value of the crops each year. These may be controlled, Sir John said, through study of the three controlling factors. Pests and parasites do harm only when they are present in an attacking state, when the plant is in a sufficiently receptive state, and when conditions are favorable to the development of the pest. Complete control of any of these three conditions would end all plant diseases, he said. If plants could be pushed through the receptive stages before the pest was ready they would escape attack. In the Sudan cotton thrips have been placed in a measure under control by giving the plants protection against the drying north wind and so maintaining a more humid atmosphere—a condition under which the plant thrives better than the pest and is past the stage of attack before the latter is ready. The best remedy, he said, still lies with the plant breeder by producing a variety immune to all diseases.

PLANT DISEASES UNLIKE THOSE OF ANIMALS

Science Service

THE path of the scientist whose job it is to safeguard the health of our crops, orchards and gardens is not a path of roses, according to Professor V. H. Blackburn, president of the botanical section of the British Association for the Advancement of Science. In his presidential address, Dr. Blackburn brought out a number of important aspects wherein the diseases of plants differ from those of animals and man, and are more difficult to handle.

The most important difference of all, perhaps, is the relatively small amount of help that the plant doctor gets from his patients. Animals and man frequently give themselves a lifelong cure of a disease by having it once; such permanent resistance is built up by an attack of smallpox—or its artificial shadow, vaccination—and is termed "acquired immunity." So far as is known, plants never acquire immunity and succumb to a second or third or twentieth attack of a disease as easily as they do to its first onset.

It is true that a plant may be naturally immune from the beginning, just as some fortunate individuals in human society are immune to some diseases from birth. But even in such naturally immune plants, as well as in those more readily afflicted, resistance to attempted invasion on the part of the disease-producing parasite is limited to a small part of the plant tissues. The struggle takes place within the confines of a few cells. This is due largely to the absence of anything like a blood circulatory system in plants. Plant sap flows only one way or at least does not flow in a closed circuit, as does blood in animals. The more perfect circulatory system of animals permits all parts of the body to manufacture resistant substances, like antitoxins, which are then delivered to the fighting front by the transportation lines of the blood system. It is the difference between mobilization with roads and without.

These two circumstances, inability of plants to acquire immunity by one attack of a disease and their lack of a circulatory system, render unlikely the development of anything like vaccination or serum therapy for plant diseases, and force us to fall back on the selection and breeding of plant strains with natural immunity, supplemented with spraying and other treatments to kill the disease-producing organisms as they alight on the leaves and stems of the plants.

There are three principal modes of attack employed by the parasites that cause plant diseases. They may get in through accidental wounds, as corn smut does to a large extent; they may go in through the breathing-pores or stomata, like wheat rust; or they may actually bore or push their way in through the unwounded plant skin. The first two methods are employed by both bacteria and fungi; the third is used only by fungi.

It has long been a riddle how a fungus, which is in the beginning a mere slender white thread, can push its way through the relatively tough skin. Early theories, which held that the fungus was attracted by some chemical substance exuded by the plant and in turn used chemical means to dissolve a hole through which it might pass, are now in abeyance. It seems more likely, in the light of recent investigations, that the affair is simply mechanical from beginning to end. The fungus thread seems to glue itself to the fated spot by means of a kind of gelatinous substance, while the central part of the thread pushes a hole through exactly like a shoemaker's awl.

Once inside, the fungus may be virulent enough to kill the tissues and make a meal of them or it may simply "live along" with them, sucking out part of their nutriment, or the tissues may turn at bay and fight. Their resistance may be physical and consist of laying down a layer of cork or other tough, impenetrable substance against the invader; or it may be chemical, meeting the poison attack of the fungus with a poison counter-attack. Sometimes this struggle is so bitter that both fungus and invaded tissue kill each other.

ORIGINAL CRUST OF EARTH SHOWS EARLY CLIMATE WAS COLD

Science Service

THE earth's earliest rocks, formerly supposed to have been formed by the cooling of the original hot, melted crust of the globe, were made in a cool climate, Professor A. P. Coleman, of Toronto University, informed the British Association for the Advancement of Science.

Although these early rocks contain no fossils their formation indicates cooler conditions than those under which the great fern forests which formed our coal measures flourished and cooler than the time when dinosaurs roamed the earth.

The evidence is growing, according to Professor Coleman, that climates and geological processes in that early time were not widely different from those of later times.

Passing downwards from the base of the Cambrian in Canada, the Keweenawan includes red sandstone suggesting desert conditions; the Animikie, with gray carbonaceous slates, was probably a time of cool moist climate; the Huronian, including the Cobalt tillite, was a time of glaciation.

Below this, after a profound break, is the Sudbury or Timiskaming series, mostly of waterformed materials, including 4,000 feet of well-banded graywacke and slate, evidently of seasonal origin. This gritty material and some boulder conglomerates make one suspect a cold and perhaps glacial climate.

After another profound unconformity the Keewatin and Grenville series with carbonaceous slate and thick beds of limestone suggest conditions not very different from the present. The thousands of feet of boulder conglomerate in the Dore series are thought by some to be torrential deposits, but might equally well be accounted for as glacial.

"On the whole," Professor Coleman concluded, "the pre-Cambrian formations indicate cooler conditions in the Paleozoic up to the end of the Carboniferous and much cooler conditions than those found in the Mesozoic."

WATER ABSORPTION IN PLANTS

Science Service

How much water plants absorb and when and why are subjects of inquiry on the part of scientists working in the laboratory of plant physiology of the Johns Hopkins University. The name of the instrument used for measuring the potations of plants is appropriately enough the "potometer." An improved form of this device, invented by Dr. B. E. Livingston and Mr. J. D. Wilson, promises to yield results of great interest to botanists and eventually of use to foresters, irrigationists and others interested in plant industry.

Heretofore all models of the potometer have been made for attachment to the cut ends of plant stems or branches. This has yielded data of some interest and value, but after all a cut branch is a wounded plant and one can not expect results to be quite normal. The device of Dr. Livingston and Mr. Wilson enables whole and uninjured plants, with full sets of roots, to be used, thus giving results more nearly approaching conditions in nature.

The Livingston-Wilson potometer is very simple in its construction—so simple, in fact, that any one can make it for his own experiments, if he so desires. All that it requires is a wide-mouthed bottle or jar, with a rubber stopper to fit it, and a short piece of slender glass tubing. The rubber stopper is pierced with two holes.

Through one of the holes a cutting of a woody stem, like willow or oleander, is passed, so that the rubber fits tightly about the bark. The cutting is allowed to stand in the jar of water until it strikes root and sets up in business as an independent plant. Then the jar is filled up level with water and the stopper set closely in so that all air bubbles are squeezed out. The piece of slender glass tubing is passed through the second hole in the stopper and filled with water. As water is taken up by the plant, the tube acts as a gauge, indicating how much goes in and how fast it goes.

With a lot of these potometer jars, the two scientists are investigating plants of several different species, determining the effects of sunlight and shade, varying temperatures, factory smoke, poisonous gases and a number of other factors upon the rate of water intake.

FOOD OF SEA FISH INFLUENCED BY TEMPERATURE, LIGHT AND SALT

Science Service

THE migrations of fishes, long a matter of much commercial and scientific importance, received light from a new angle in discussions before the meeting of the British Association for the Advancement of Science by Professor A. G. Huntsman, of the University of Toronto. Professor Huntsman studied, not the fishes themselves, but the host of minute plants and animals, called the plankton, that constitute their chief food. Influences that control the movements of the plankton must also control to a large extent the movements of the fish that feed on them.

Professor Huntsman has found that the organisms in the plankton respond in the main to three sets of influences: light, temperature and degree of saltiness or salinity. Light does not penetrate into water to any great depth; below a few hundred feet the world of the waters is perpetually dark. Some of the animals in the plankton like the dark and dive toward the bottom during the day, while others like the light and luxuriate on the surface during the sunny hours. They are similarly affected by differences in temperature, being distributed both in depth and latitude according to the prevailing temperature of the water. Finally, salinity affects them. The ocean is not equally salty everywhere, but has more salt in quiet waters that receive few rivers, especially in tropic latitudes, where evaporation rates are high, like the Mediterranean and Red seas, and less salt in regions where much fresh water or ice comes in and there is little evaporation, as in the Arctic Ocean. It is the influence of such conditions as these that makes for differences in the amount and distribution of the plankton and hence on the movements of fishes.

Ocean currents complicate the situation by mixing up waters of different temperatures and salinities. Warm waters, like the Gulf Stream and Japan Current, profoundly affect the cold-water life of the northern oceans, while cold waters of low salinity, like the Labrador Current, reverse conditions in the warmer southern areas.

ITEMS

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DR. PAUL E. SABINE, director of the Wallace Clement Sabine Laboratory of Geneva, Ill., speaking before the section of physics of the British Association, stated that transmission of sound through masonry walls does not depend on the material or its structural stiffness, but varies in proportion to the weight of the wall per unit of its area. Dr. Sabine's researches have the double object of minimizing echoes and reverberations in auditoriums and of assisting the construction of sound proof rooms. From his work on the transmission through partition walls of non-musical impact sounds, such as the clicking of a typewriter, he has developed equations which predict what fraction of sound energy will be absorbed by flexible structural units of wood, glass and steel, on the one hand, and ''deadening quilts'' of porous material on the other.

FELLOW feeling between the eyes was brought into play in experiments conducted to discover the fundamental processes of color vision, Professor Frank Allen, of the University of Manitoba, told the section of physics of the British Association. The left eye first was fatigued with a series of monochromatic spectral colors and the effects produced on the right eye measured through the critical frequency of the flicker. The results showed the existence of visual sensory reflexes, the chief effect of which is to enhance the sensitiveness of the receptors of all three fundamental color sensations in the right eye. In a similar manner the right eye then was fatigued and both direct and reflex effects simultaneously were produced. The simple colors, red, green and violet, affect one sensation directly and two reflexly. The compound colors, orange, yellow and blue, affect two sensations both directly and reflexly. Similar experiments were tried by confining fatigue to one side of the retina and measuring the reflex effects produced on the other side. They were precisely the same as in binocular experiments.

HOW the bodies of man and other warm-blooded animals are kept at an even temperature, and always at the same temperature, was the subject of a paper before the British Association by Drs. W. B. Cannon and A. Querido, of Harvard University. Evidence has been obtained that the secretion of the adrenal glands, small bodies situated near the kidneys, is increased when there is liability of lowered temperature through the loss of heat from the body. When animals deprived of the use of the adrenal glands are threatened with chilling, they shiver, whereas normal animals exposed to the same temperatures do not. This is held to indicate that the former ''feel the cold,'' for shivering is known to be a sort of emergency method of getting warm. It has been known for some time that adrenalin extract has the effect, when injected into the blood stream, of speeding up the oxidative or fuel-burning processes in the body.

ELECTRIC lamps, many of them automatically operated, are replacing oil and acetylene lamps used in the 5,800 shore beacons and buoys that warn ships of dangers along the coasts of the United States.