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IS IT MOONSHINE?

By Dr. Edwin E. Slosson.

A couple of years ago an Englishwoman, Miss Elizabeth S. Semmens, was told by an old gardener that seeds planted in the first quarter of the moon germinated better than when planted in the dark of the moon.

Being a scientist as well as a woman, Miss Semmens was endowed with a double dose of curiosity, so she set herself to find out, first, if it were so, and second, if so, why?

Miss Semmens began by exposing different samples of the same seed to moonlight and to sunlight and she found that more seeds germinated in the moonlit set than in the sunlit set. This indicated that there might be something in the old idea. Anyhow it seemed worth investigating more closely.

At first thought the notion seemed alsurd for moonlight is half a million times weaker than sunlight so how could it be more effective in stimulating plant growth.

Besides, moonlight is sunlight for the moon shines only by the reflected rays of the sun.. Has the sunlight undergone any change in quality by being reflected from the moon besides being diminished in quantity? In one respect it has, though nobody ever thought it made any difference. Reflected light is polarized. Light consists of vibrations across the line of sight. If we look at a lamp on the other side of the room, the light waves in the ray coming to us move up and down, right and left, and all the angles in between. But if the ray of light is reflected in a mirror at a certain angle, part of the vibrations, say the sidewise movements, are quenched and the ray of reflected light consists mostly of vibrations in one plane say up and down. Such light is called polarized because the vibrations have polarity, that is, motion to and fro in one line of direction. The eye cannot tell the difference between polarized and ordinary light and we do not like to think that plants are brighter than we are in any respect.

But we have to admit that there are some things that a plant can do and we cannot. One of them is the building up of starch out of glucose which the plant accomplishes with ease but which we are not yet wise enough to do. The reverse process, the breaking down of starch, we can do and do do in our glucose factories where thousands of tons of cornstarch are turned into syrup. This is accomplished in the factory by soaking the starch in warm water and adding a little acid. The plant gets the same result by using, instead of acid, a minute amount of a ferment called diastase.

In order to see if polarized light had any effect upon the digestive processes of the plant, Miss Semmens placed some grains of starch in a weak solution of diastase on a microscope slide and threwupon it a beam of polarized light, using a

mirror instead of the moon for reflecting the ray because it is handier to handle. Another slide of the same sort was exposed to ordinary diffused sunlight, mostly not polarized, and a third was kept in the dark. The starch was actively attacked and dissolved under polarized light; very slowly in the ordinary sunlight, and not at all in the dark. The temperature was kept the same for all three slides, too low a temperature for the starch to dissolve under ordinary conditions. In some cases artificial light was substituted for daylight, and the light was either polarized by reflection from a glass-covered ferrotype plate or by passing it through a Nicol prism, which consists of a calcite crystal cut in such a way as to divide a ray of ordinary light into two rays, polarized at right angles to each other.

The progress of the process could be made plain by treating the slide with two well known reagents. A drop of tincture of iodine will turn starch dark purple Glucose treated with an alkaline solution of a copper salt will throw down metallic copper as a bright red powder.

Miss Semmens showed me some of her photographs and slides on a train in Canada last month. Where the polarized light had been at work for awhile the purple starch grains disappear and appear in later slides as coppery spots of glucose very plain and very pretty. A starch grain seen through a microscope looks like a big clam shell. Those that were being eaten away by the diastase under polarized light were notched and nicked all around the edge, like a cake that had been nibbled at by a small boy.

When Miss Semmens announced her results, they were received with much surprise and considerable skepticism. Nobody had ever seen such an effect by polarized light. Which is not strange, considering that nobody ever seems to have looked for it. Also, it was pointed out, the experiments were delicate, the results microscopic and the liability of error great. And finally, what reason was there for thinking that the reactions observed under the microscope actually occurred in the plant.

But Miss Semmens - well, you know how women are, the more you tell them that they are wrong the more apt they are to prove themselves right. In spite of the incredulity of experts, she went on with her work. She obtained funds for reserach from her college, Bedford College for Women in London. She made a convert to her views in Professor Baly of Liverpool University who has been carrying on remarkable researches in the synthesis of sugars by electric light, and she went to Liverpool to work with him. Then she crossed the Atlantic to continue her experiments under Professor Lloyd of McGill University, Montreal.

She has proved that polarized light thrown upon a living leaf will stimulate the dissolution of starch grains just as it does on a glass slide. Now when the insoluble starch molecule breaks up it splits into two molecules of glucose. Increasing the number of molecules in the cell sap must cause an increase in the solution pressure and so a swelling of the cells. The mouths through which the plant breathes, the stomata of the leaf, are closed and opened by two guard cells which act like lips. When these swell and stiffen the mouth closes. These guard cells are filled with starch and when this breaks down into sugar the cells become turgid and so open the slit. Miss Semmens has found that polarized light has this effect and so may account for the opening and closing of the stomata as the daylight changes.

Just before sunrise, and after sunset, the light we get is largely polarized since it comes to us by reflection from particles in the air. As the sun rises

to the noon height, the proportion of direct light becomes greater and of polarized light less. This is the time when starch is formed in the green leaves by the sunshine but after six o'clock, when the vertical light from the evening sky striking the leaves is polarized, the starch begins to dissolve into glucose.

It is a new field into which Miss Semmens has entered and if her results stand the test of further investigations, they may give a clew to many a problem of plant and animal life. She herself regards the question as still in the tentative stage, and, while she is confident of the validity of her experiments, she religiously resists the temptation to speculate as to their possibilities, at least in public.

It would be foolish of me to rush in where she fears to tread but I cannot refrain from calling attention to the importance of polarization in vital processes. It is well known that many of the substances found in plants and animals, notably starch and sugar of all sorts, have the peculiar power of twisting around a ray of polarized light as it passes through them. They are, as the chemist calls it, "optically active". The molecule is so constructed as to have a sort of corkscrew action on such light. Thispeculiarity is taken advantage of in sugar analysis. When the chemist wants to find out how much sugar a beet contains he simply squeezes out the juice and puts it into a tube of known length, capped with glass at both ends, looks at a ray of polarized light passing through it, andreads off the percentage of sugar. Some sugars rotate the ray to the right, others to the left, in different degrees but always the same for each sugar. The right and left screw-forms of the same substance often have different physiological effects. Certain kinds of bacteria willeat a left handed compound while rejecting its right handed twin. But when a chemist makes one of these vegetable compounds artificially, it usually turns out to be inactive because the two opposing forms are mixed or combined so as to neutralize each other. Since so many natural substances have an effect on polarized light, it would not be surprising after all if it should be found that polarized light had an effect on them.

Then there is reopened the question of the moon which in all ages has been supposed to exert a mysterious influence upon - but I really must stop lest I wander beyond the legitimate range of the scientific imagination.

TUBERCULOSIS CURES DIABETES SWEDISH PHYSICIAN DISCOVERS

The curious fact that diabetes can sometimes be cured by tuberculosis has led a prominent Swedish specialist, Dr. Erik Lundberg, to researches and discoveries which promise to have important effect on the future treatment of both diseases. This is of special interest in connection with the widely-heralded use of insulin in the relief of diabetes. Proceeding on the theory that in the case of consumptive patients insulin, or something similar, is secreted outside of the pancreatic gland, Dr. Lundberg experimented with mice which he infected with tuberculosis and then dosed with insulin. He succeeded in producing insulin poisoning which led to instant death, except where he made injections of grape-sugar along with the insulin. He found that the injection of about one-half cubic centimeter of a solution of 10 per cent grape-sugar resulted in immediate recovery from the insulin poisoning.

From these experiments Dr. Lundberg has concluded that insulin is secreted by the tubercular granular tissue, and that this substance is everywhere present in the human organism in very small quantities, where the secretion is greatly stimulated in some way under the influence of tuberculosis bacilli or their toxins.

THE SUN'S PLACE IN THE UNIVERSE

By Isabel M. Lewis,
of U. S. Naval Observatory.

Statistics of the stars, which are becoming increasingly valuable each year as the astronomer finds new and illuminating data continually coming to hand, do not give our sun such a flattering position in the universe as we might wish. A small, yellow, dwarf star is its rating in a universe of some hundreds of millions of stars, similar in size and appearance to many million other stars; its position fifty light years above the central plane of the Milky Way and fifty thousand or more light years from its center, in the midst of a local star-cloud, not over three thousand light years in diameter, which is more or less permeated with and enveloped by vast expanses of dark nebulous matter.

It was but a few centuries ago that man looked upon the sun as an attendant of the earth which was then held to be the center of creation. Then it came about, surprisingly, that the sun was after all the ruler of its own system and the earth an attendant of the sun, a rather puny one at that compared to some members of the solar system. It was a thought to which the human race has not yet completely adjusted itself. Still man clung to the belief that the sun was the center of the universe, for the distances and distribution of the stars were unknown. It was the general idea that the stars were all equally far away, arranged in a sort of spherical shell with the sun at the center. Another unpleasant shock was still to come to the geocentrically inclined members of the human race. New and surprising facts about this sun of ours were gleaned from the life studies of many astronomers as the years passed on. The stars were not all equally distant but were flowing to and fro in streams in or parallel to the Milky Way and the sun was moving onward through space at the rate of a million miles a day, one of the units in a star stream. The distances of the stars turned out to be tremendous, inconceivable. The nearest star was something like twenty-six trillion miles away. Its light took four and a third years to reach us though it traveled 186,000 miles every second. Other stars were found, ten, a hundred, a thousand times more distant. Each star had the comfortable elbow room of several trillion miles on the average, its distance from its nearest stellar neighbor. Old, conservative ideas of the universe were completely upset. As a last straw for the old geocentric theorists came the discovery of the present decade that we are something like fifty thousand light years from the center of the universe, or possibly <u>one</u> universe, which consists of the vast lens-shaped aggregation of hundreds of millions of stars known as the Milky Way or Galaxy with its center far away in the direction of the star clouds of Sagittarius.

Though Dr. Harlow Shapley's estimate of three hundred and fifty thousand light years for the diameter of the Milky Way has not passed unchallenged by some astronomers who consider it of the order of ten times too large, the general weight of the evidence at present seems to be in favor of this greater estimate of the size of the Milky Way. It is to the Milky Way system of stars that our own sun belongs and through it we are moving with the sun, about which we circle, at the rate of a million miles every day, six million million or six trillion miles in 15,750 years.

At that rate it would take us pretty close to eight hundred million years to reach that coveted position at the center of the universe. But the sun is old, at least several billion years old, it is suspected, and, who knowns maybe we were there once in past ages and will get there again some day!

SUN HAS VERY LOW PRESSURES AT SURFACE

What pressure does the sun's "atmosphere" of gaseous metals exert on its surface?

Drs. H. N. Russell and J. Q. Stewart, astrophysicists at Princeton University have evidence that it is very low - so low, indeed, that pressures of the same magnitude may be produced on earth only artificially, and are then reckoned as fairly well-developed vacua.

By mathematical manipulations of the known facts about the solar spectrum, the degree of brightness of different levels in the outer coat of the sun, and the properties of electrons and atoms, they reach the conclusion that at the surface of the photosphere, which is the outside of the opaque, and apparently though not really, "solid" part of the sun, the pressure is less than one one-hundredth of an atmosphere. In the "reversing layer", which is part of the gaseous envelope about the sun, the pressure is not greater than one ten-thousandth of one atmosphere. The whole amount of material in the thousand-mile deep solar atmosphere, if compressed to the density of the ordinary air, would make a layer less than ten feet thick.

RADIUM EMANATION CHANGES GAS TO OIL

Radium emanation, acting upon ethane, a constituent of natural gas, has changed it into an oily liquid, probably octane, in the laboratory of Drs. S. C. Lind and D. C. Bardwell, of the U. S. Bureau of Mines. Octane is a light, volatile, highly combustible liquid, and is one of the principal ingredients of ordinary naphtha.

Whether there are commercial possibilities in the process, the discoverers did not wish to conjecture; the experiments so far performed are only preliminary, they pointed out. They are continuing their investigations.

This is the first instance on record of the conversion of a lower hydrocarbon to a higher one by the use of radium emanation. A somewhat similar occurrence took place, however, several years ago, though it was never reported to the scientific world. Prof. B. B. Boltwood of Yale University and Sir Ernest Rutherford of Cambridge University, England, found that the same radium emantion changed ordinary soft paraffin into a form of paraffin so hard that it would melt only at a temperature nearly great enough to make glass red hot.

The conversion of lower hydrocarbons into higher forms depends on driving off part of the hydrogen. Hydrocarbons, both liquid fuels and gases, are made of carbon and hydrogen in varying proportions. The larger the proportion of carbon the "higher" the hydrocarbon. Ethane, for example, the material with which the present experiments were begun, contains two parts of carbon and is a gas. Octane, which is a liquid, contains eight parts of carbon and eighteen of hydrogen; or a proportion of four to nine, as compared with one to three in ethane. Considerable quantities of free hydrogen were given off during the experiment, showing that the gas was being partly broken up by the radium bombardment, and then reorganizing into the higher form, or octane.

One possible value of the discovery may be its aid in understanding the formation of natural gases and oils in the earth. The alpha radiation of radium is

presented everywhere in the rocks, and it may therefore have had a good deal to do with the building up of petroleum deposits from the organic masses left behind by the life of past geologic ages. One difficulty remains to be explained away, in the opinion of the two investigators. Petroleum and gas wells do not give off hydrogen. In any event, however, the discovery is one of the most important of recent developments in hydrocarbon chemistry.

REVOLUTION IN TRANSPORTATION FROM NEW ELECTRIC LOCOMOTIVE

Electric locomotives of a new type, that carry their own transformer stations and "step down" a high voltage alternating current to a low-voltage direct current, are being installed on the New York, New Haven and Hartford Railroad, and according to statements of William S. Murray, engineer in charge of electrification, promises to open a new era in motive power for railroads.

One of the main obstacles in the way of complete electrification of railroads has been the wide differences in the requirements for transmission of electric current and for its best use. Electricity is most economically transmitted as alternating current of high voltage. It can be most efficiently and economically used as direct current at low voltage. Until the present time, electromotive engineering has had to be content with compromises. Less economical types of motors have had to be used, and railroads have had to maintain costly "step-down" transformer stations along the right of way. The new locomotives carry their own transformers with them, and change 11,000 volt alternating current which they take directly from the trolley wire to lower voltage direct current which is fed to their motors.

Six of the new type of electric locomotives have been built by the General Electric Company for this railroad, and are being given a thorough test under working conditions. Four of them are used in regular train service, and two in yard service for switching purposes.

BABYLON TRADED WITH INDIA 2000 YEARS BEFORE KING TUT

Evidences of commerce between the ancient cities of Babylon and India three thousand years before Christ have been brought to light by British archaeologist in India.

Sir John Marshall, director general of archaeology in India, has communicated results of excavation in the Punjab and in Sind which, according to experts such as Professor the Rev. Archibald Henry Sayce, late professor of Assyriology at Oxford University, "open up a new historical vista and are likely to revolutionize our ideas of the age and origin of Indian civilization."

Hitherto little has been known of Indian history earlier than the third century before Christ, but the Indian Archaeological Department investigating at Harappa in the Montgomery district of the Punjab and at Mohenjo-Dara, Sind, places some 400 miles apart, has unearthed relics which appear to prove that about three thousand years before Christ there was close contact between Indian and Babylonia. The finds include new varieties of pottery, both painted and plain, some fashioned by hand and some turned on the wheel; terracottas; toys; bangles of blue glass, paste and shell; new types of coins or tokens; knives and cores of chert; dice and chessmen; a remarkable series of stone rings; and, most important of all, a number of engraved and inscribed seals.

The discoveries have aroused very keen interest at the British Museum, and

Messrs. C. J. Gadd and Sidney Smith of the Egyptian and Assyrian Antiquities Department by comparing them with relics of Babylonian civilization known to be dated about 3,000 B.C. are able to point out that there exists so close a relation as to prove that there must have been contact between Indian and Babylonian civilizations at the date. It is remarkable that neither the Indian humped-bull nor the water buffalo are represented, though in some instances the animals are bulls of very definitely Sumerian type.

COTTON ACQUIRES A NEW CAMOUFLAGE

By Dr. Edwin E. Slosson

Cotton is a social climber. Hanicapped by its lack of the sheen of silk or the luster of linen or the warmth of wool, it is now gaining upon its rivals by aid of the chemist.

Silk, the aristocrat of textiles, gets the gloss that is the envy of the rival fibers from being forced out in a viscous from from the tiny orifices of the spinnerets of the silkworm, solidifying as a single slick smooth cylinder a thousand yards long.

Cotton, on the contrary, if you compare it under a microscope, looks like a short twisted tape, and wool like a rough and scaly rope. Cotton, to quote an old joke, shrinks from soaping - like a small boy, Dipping cotton into strong alkali causes the fibers to shorten and thicken and soften. Seventy-five years ago it occurred to an English chemist, John Mercer, to try what would happen if the cotton were not allowed to shrink.. So he kept the thread or cloth on stretchers while it was dipped into a solution of caustic soda and left to dry under tension. The lye took the kinks out of the cotton and softened its surface and this gave it something of the luster of silk. So Mercer immortalized himself, like J. L. MacAdam, the road-maker, by converting his name from a proper noun to a verb, and we have had "mercerized" cotton ever since.

Now a new method of treating cotton has been invented. This is the opposite of the mercerization process for it is produced by acid instead of alkali. Charles Schwartz of the Philana Company at Basle, Switzerland, has found that cotton may be made to resemble its other rival, wool, by immersing it in concentrated nitric acid. The fibers become more curly and their surface rougher, and the fabric assumes the texture of a new material to sight and touch. The tensile strength is said to be increased by fifty per cent. and the resistance of the surface against scraping to be improved by two hundred per cent. In wear and warmth and appearance the philanized cloth resembles woolen.

We might suppose that the action of nitric acid on cotton would produce nitric-cellulose, otherwise known as gun-cotton. It would not be pleasant to go about clotheed in a high explosive. But in making nitro-cellulose sulfuric acid is needed to facilitate the reaction of the nitric. In the present process the nitric acid merely attacks the surface and is all washed out afterward, or eliminated by alkali. The cotton acquires a yellowish tinge but this may be removed by bleaching. The philanized fabric may be later mercerized and this makes it look like linen. It is said to dye more readily and brilliantly than untreated cotton. One of the leading German dye works is using the new process.

In England nitric acid is being applied to the improvement of ramie, an

Indian fiber. When ramie under tension is treated with nitric acid, it acquires a silken luster. When not stretched, it resembles wool. Three minutes dipping in the cold concentrated nitric acid is sufficient for the effect. The fiber gains slightly in weight and considerably in strength and takes dyes better.

The chemist has made a new market for cotton waste by dissolving it completely in nitric acid, alkaline sulfide, or acetic acid, and spinning out the viscous fluid into threads of any length, size and shape that he pleases, producing thereby a synthetic fiber that closely simulates silk in appearance if not in strength. Fifty per cent. of what seems to be silk nowadays comes from the chemical laboratory instead of from the cocoon. By taking on the chemist as an ally King Cotton is enlarging his realm.

IODINE REQUIREMENTS FOR WATER DISCUSSED AT PUBLIC HEALTH MEETING

The needs of inland populations for iodine in diet or water supply, to prevent the incidence of goiter, were the subject of a report to the American Public Health Association by a committee on nutritional problems, under the chairmanship of Dr. Henry C. Sherman of Columbia University.

Dr. Sherman pointed out that in regions near the seashore the iodine necessary for good health is borne inland to considerable distances as spray on the wind. But in regions remote from the sea or cut off by mountains, there arises a lack of iodine, and a consequent increase in the occurrence of goiter.

Very little iodine is necessary to prevent goiter - only about one part in three million parts of the body weight. This may be supplied, in inland places, by adding slight amounts to city water, by the addition of iodine salts to common salt, or in other ways introducing it into food, or by using in the diet small quantities of sea plants which have been found to be rich in iodine.

"TIN CAN TOURIST" PRESENTS SERIOUS SANITATION PROBLEM

Sanitation problems presented by various classes of vacationists and tourists, were the subject of a discussion before the American Public Health Association, in session at Detroit, by John M. Heller, engineer in the Michigan state department of health.

After considering the problems presented by the more or less permanently located vacation resorts, such as hotels, private cottages, and lakeside resorts, Mr. Heller devoted special attention to camps. Tourist camps maintained by municipalities or by popular subscription, he pointed out, were not receiving adequate attention for their sanitary needs. Chemical disposal of waste and sewage, a means employed in many state parks, has not proven satisfactory, he asserted.

The melting point of thorium oxide, the substance of which gas mantles are made, is over 6000 degrees Fahrenheit, approximately twice as high as the melting point of platinum.

VIRGINIA DOCTOR EXPLAINS RACE INTEGRITY LAW

Eugenical marriage regulations, as one phase of them is developed in the Virginia racial integrity law, were discussed before the Detroit meeting of the American Public Health Association by Dr. W. A. Plecker, State Registrar of Vital Statistics of Virginia.

Dr. Plecker pointed out that the American race problem started within twelve years after the first English settlement in America, when negro slaves were introduced. The Virginia law prohibiting intermarriage of white and colored persons was placed on the books, he declared, because it has been shown that where different races come into contact there is always a tendency for them to intermix; and it is believed that our civilization depends upon keeping the purity of the white race intact. He urged the nineteen states that now permit legal marriage of whites with colored or mixed bloods, to adopt laws forbidding it.

MANY CANNED FOODS HAVE HIGH VITAMIN CONTENT

Canning foods does not necessarily destroy their vitamin content, is the opinion expressed by Dr. Walter H. Eddy of Columbia University, before the meeting of the American Public Health Association at Detroit.

The principal vitamin looked for in fresh vegetables, Dr. Eddy said, is the scurvy-preventing, or "antiscorbutic", water-soluble Vitamin C. Early experiments indicated that this vitamin is destroyed in long cooking or processing at high temperatures, but more recent work has shown that exposure to oxidation during heating is a necessary step in the destruction. By sealing the cans before heating and thus excluding air, properly conducted commercial canning processes can easily leave the vitamin intact through long processing periods. Dr. Eddy cited the now acknowledged antiscorbuting value of the juice of canned tomatoes as an example of the possible high value of canned foods as sources of vitamin.

HEALTH PROBLEM OF SAMLL CITY DIFFICULT, SAYS YALE DOCTOR

Public health in cities of twenty to thirty thousand population is far less efficiently safeguarded than it is in larger places, according to Prof. Ira V. Hiscock of the Yale School of Medicine, who addressed the American Public Health Association, at Detroit. Prof. Hiscock has made a detailed study of smaller cities in Connecticut.

In communities of this size, he pointed out, there is a lack of full-time employees, trained in modern health practice. Too frequently the combination job of health officer and school physician becomes a political "plum". The appropriations for official health work in over nine-tenths of these towns are inadequate for the development of a complete health progress.

Volunteer work by partly qualified nurses, cooperation by parents in health undertakings fostered though the public schools, and a gradual awakening of public feeling, promise possible improvement in the future.

AERO EXPERT TELLS OF PLANE TESTING METHODS

When an aerophane reaches a speed of three hundred miles an hour or more, or a great bomber climbs to the clouds carrying a couple of tons, back of the daring pilot are the engineer and the physicist who give hima perfected machine that will respond to the demands he makes on it. Prof. Joseph S. Ames of the Johns Hopkins University, chairman of the executive committee of the National Advisory Committee for Aeronautics tells in the Annual Report of the Smithsonian Institution of the work of the scientists in the laboratories that makes possible the record-breaking flights.

Two principal methods, according to Dr. Ames, are used in testing improved models of wings and other airplane parts. One, the free-air method, consists in carrying the part to be tested beneath an airplane in flight, with instruments attached to measure its behavior. The other method consits in placing the test parts, built in the designed shape but on a smaller scale than in service models, in a specially constructed tunnel, and driving against them a current of air moving at the airplane speed.

For testing models of high speed airplanes a special type of wind tunnel is necessary, so as to simulate the conditions the planes meet in actual flight. This tunnel is built inside a tank, in which the air can be raised to as much as twenty-five atmospheres, or 375 pounds per square inch.

Research in aeronautics most needed at present, says Dr. Ames, is included under the following heads:

1. Investigation of the properties of propellers operating at a considerable angle to the line of flight. Information must be gained on this point before successful helicopters or machines rising vertically can be built.

2. A greater range of speed for any one airplane, so that it may attain a great flying speed and yet have a slow landing speed.

3. Reduction of the "drag", or resistance of aircraft. Much experimentation in the distribution of weight, arrangement of engine and propeller, position of fuselage, etc., must be carried on to approach a solution of this problem.

4. Greater refinements of wing form, in the interests of greater efficiency and economy.

TABLOID BOOK REVIEW

THE BIOLOGY OF FLOWERING PLANTS: By MacGregor Skene. New York; The Macmillan Company, 1924. 523 pages.

This book will be welcomed as a very useful addition to the libraries of all botanists, but especially to those of ecologists and plant physiologists. The author's avowed approach to ecological problems is from the physiological side; this fits the book into exactly the right place at the right time, meeting in an especially happy manner the needs of teaching botanists in this country, who are endeavoring to depart from the old strictly morphological attack and to make plants "look alive" for their students. Since this is the first book of major importance on plant physiology that has appeared for some years, it has the advantage of collating for the first time the results of recent researches, like those of Weaver and Cannon on roots, and of Livingston and his pupils on transpiration. The treatment of the difficult subject of stomatal action is especially commendable, and the section on reproduction is very full and well handled. ----------