SCIENCE NEWS

RESPIRATION IN PLANTS

Science Service

PLANTS breathe with their feet as well as with their heads, and there is oxygen enough in good garden soil for their needs. These are discoveries of Professor Burton E. Livingston, of the Johns Hopkins University, and Dr. Lee M. Hutchins, of the U. S. Department of Agriculture, working in the former's laboratory of plant physiology.

Earlier work by these men and by other scientists had already established the fact that plants must get their oxygen through their roots as well as through their leaves, and that air taken in through the top of the plant does the roots little or no good in most species. It has, of course, been long observed that many kinds of plants "drown" when they stand for a considerable period of time in flooded land, even though their tops may be above the water. This "drowning" of a plant is exactly like the drowning of a man: both die of suffocation, or lack of oxygen. That the plant has its head above water does it no good; it has no lungs or circulatory system to pass the air down to its roots, and if they can not get oxygen from the soil they can not get it at all.

Livingston and Hutchins then proceeded to develop a most ingenious method for measuring how much oxygen the soil can supply in a given time. A cone-shaped filter of thin porous porcelain is sunk into the soil to be studied, and allowed to remain until the earth settles around it. Then nitrogen, from which the last trace of oxygen has been extracted, is fed slowly through from a storage tank, and as it passes out again is run through a sikytu solution of pyrogallol, a chemical that turns brown in the presence of oxygen, and can be used to measure the amount that has come in through the walls of the filter.

By this method it was found that three factors influence the rate at which oxygen can pass through the soil to the roots of plants. Tightly packed soils can supply little oxygen, while well-cultivated soils pass it through easily. The rate of supply depends also on the amount of water present: the more nearly waterlogged the soil the lower the rate of oxygen movement. Finally, the deeper the soil level the slower is the rate of supply.

The natural distribution of plants is governed at least in part by the amount of oxygen their roots need. Plants of wet habitats, like rice, willows and cattails, require little oxygen for their roots; corn, potatoes and other crops of well-cultivated lands require a great deal. Ordinary forest trees for the most part occupy an intermediate position. It is expected that the new method will in time yield data of great value in botany, agriculture and forestry.

ACTIVITY OF KILAUEA VOLCANO

Science Service

THE Hawaiian volcanoes are popularly supposed to be the most placid in the world, but they sometimes belie their reputation. Kilauea volcano on the eighteenth of May of this year produced an explosive eruption quite comparable to those of Vesuvius.

This was not wholly unforseen, for we know that natives were killed by a blast from Kilauea 134 years ago. It is known also from Japanese statistics that 130 years is a critical interval between eruptions of many volcanoes, and a suspicion that this might apply to Kilauea led us in 1918 to publish a warning that about 1920 might be a dangerous time.

The warning was abundantly justified. The year 1920 produced tremendous lava flows, for the next four years the lava sank lower and lower within the mountain, and in 1924 the famous fire pit of Kilauea collapsed violently so as to plug the accumulated gases beneath, and a terrible explosion ensued.

We do not yet know the cause of such explosions, but there is much evidence from observations made during the last ten years to justify the working hypothesis that the lava sank so low as to let the rain water underground close over the crack containing the glowing slag. There is everywhere a great sea of underground water in all lands. In Hawaii the rocks are so porous that this water stands inside the island at a very low level, so low that it can not be reached by ordinary wells, but flows out as sea-level springs. Ordinarily the lava column at Kilauea crater must cover itself with a shell of hardened slag in the shaft beneath the volcanic vent, and keep the water out by evaporating it with its heat.

This year, however, there was a swarm of earthquakes in Puna, at the east end of Hawaii. The ground cracked open in huge crevasses, as though a lava flow were going to break out at sea level. The ground, however, subsided. Then the fire pit 3,700 feet higher near the summit of the mountain began to cave in, great black clouds of avalanche dust shot upwards, the pit grew bigger and bigger, steam appeared, and then the black clouds growled and roared and hurled out huge broken rocks without a particle of fresh lava. It was just as though the pit had been converted into an upright quarry with big blasts let off at intervals of about six hours. Boulders weighing ten tons were hurled hundreds of feet from the explosion center. Dust curdled into rain clouds and came down as mud balls. Gutters on the hotel roofs broke down with the weight of rock powder. A man trying to photograph the pit at close range was killed by a barage of boulders. The eruption lasted two weeks and the great cauldron left was 3,500 feet long and 1,300 feet deep.

All the other activities of Kilauea have shown fresh black glassy lavas and so do the other Hawaiian volcanoes in most of their eruptions. Until last February the fire pit was full of boiling lava fountains. The succession of events since 1914 has been: Outpouring of lava at 13,000 feet above the sea, then 8,000 feet, then 3,000 feet and finally this inpouring at sea level itself. It seems logical to conclude that such explosive eruption is a secondary matter occasioned by the plugging of the vent, the closing in of the underground waters, and the consequent development of enormous steam pressure. The interesting feature of this is that the water explanation accounts, not for ordinary lava activity, but only for the exceptional crises of explosion. Explosive eruption at a lava volcano is a secondary phenomenon, and primary volcanism may be fundamentally dependent on hydrogen and other deep gases.—T. A. Jaggar, Jr.

GIANT STARS OF THE MAGELLANIC CLOUDS

Science Service

THE most conspicuous stars in the Magellanic Clouds are greater in size and in brightness than any of the giant stars heretofore known to astronomers, according to investigations just announced by Dr. Harlow Shapley, director of the Harvard College Observatory. Many of these stars are believed to excel the far-famed red giants Betelgeuse and Antares, and in diameter probably approach the diameter of the orbit of Jupiter, some 966,600,000 miles.

Extensive photometric work has led finally to the determination of the distance of the Small Magellanic Cloud. Similar investigations are under way for the Large Cloud. These stellar systems, which are visible only in southern latitudes, derived their name from descriptions given four hundred years ago by the navigator Magellan. They look like large patches of the Milky Way, but are quite detached from the Galaxy.

Through a prolonged study of the variable stars discovered in the Magellanic Cloud by Miss Leavitt at the Harvard Observatory twenty years ago, a method has been developed for the determination of the distances of star clouds and clusters. Only this year, however, has it been possible to give a decisive value for the magnitudes of the stars in the Small Magellanic Cloud, and consequently to measure the distance and dimensions of the system. It is now found that the diameter of this cloud is sixty-five hundred light years. The distance from the earth is thirty-two kiloparsecs, which is equivalent to a little over a hundred thousand light years. A study of the luminosity of our sun would at this distance be of the twenty-third magnitude.

Stars as faint as our sun in this cloud, however, are far beyond the range of modern telescopes. The studies of brightness on the Harvard photographs, which were made at the Arequipa station in Peru, go down only to the stars of the eighteenth magnitude.

More than half a million stars that are at least a hundred times as luminous as our sun are contained in the Small Magellanic Cloud. A few hundred of them have each more than ten thousand times the solar brightness. The very brightness of the super-giants are shown by photographs of their spectra to be of the redder classes of color. Hence the intensity of light emission must be low, and, to account for such high total brightness, the dimensions must be exceedingly great. It is calculated that the diameters of the largest super-giants are nearly a thousand million miles. This is at least three or four times the diameter of Betelgeuse, and is probably very near the maximum diameter possible for a luminous star.

The Small Magellanic Cloud is known to be receding from the Galaxy with the enormous velocity of a hundred miles a second. Dr. Shapley points out that almost certainly both the clouds of Magellan were in the Milky Way at a time more recent than the paleozoic era, and were then indistinguishable from the other star clouds of the Milky Way.

THE "PLANETARIUM"

Science Service

AN instrument that is expected to have a great influence on the teaching of popular astronomy has been installed at the German Museum of Natural Science and Technology at Munich. It is the product of the optical firm of Zeiss, and has been under construction for five years. The chief advantage of the machine lies in the fact that it substitutes a realistic and accurate picture of the happenings in the heavens for a confusing arrangement of wires and wooden balls heretofore used.

The "planetarium," as the instrument is called, is of unusual, even weird and startling, appearance. There is something about its general make-up that would suggest a small anti-aircraft cannon, but instead of ending in a long barrel, it has as its most essential part a large sphere studded with high-power lenses, resembling a gigantic insect's eye. Each of these lenses is arranged to project the image of a certain part of the heavens, so that the whole starry universe can be made to march across the dome-shaped ceiling of the "sky room" where the planetarium is housed.

All stars down to the sixth magnitude are shown, as well as the milky way, the planets, the sun and the moon, The instrument can be rotated at any speed, showing the celestial events of a day in a period of four minutes, or crowding a year into fifty seconds. Within the artificial sky of the planetarium study, the operator has the power of a Joshua; for he can bid the sun and moon to stand still, and cause the stars to run backward in their courses. So accurate is the instrument that after rotations representing five thousand years there is an error of less than two degrees.

AN AUTOMATIC REGULATOR

Science Service

A MECHANICAL device so sensitive to pressure that the breath of a child directed into a funnel can release enough power to lift many tons of weight, and so sensitive to temperature that the heat coming from a man's hand held near a metal strip will effect the same result, has been perfected in Sweden after three years of experimentation and through tests in actual use.

This remarkable multiplication of power is, however, only an incidental feature of the apparatus, which takes the place of a man in an industrial establishment opening and shutting all sorts of regulating valves automatically and with an accuracy that no human being could ever achieve. The new apparatus can, for example, keep the temperature of a room within a quarter of a degree of the value desired, and can keep steam pressure from changing more than two ounces per square inch. It can also regulate electric current, speed, dampness or dryness, density of liquids, viscosity and vacuum.

This new regulator, which was invented by the Swedish engineer, Ragnar Carlstedt, is based on one of the simplest of all mechanical principles, namely, the harnessing of a flowing current of water. In other words, if it is desired to open or shut the valve of a steam radiator in a room, this work is done by turning on water pressure from one of the water pipes of the house, instead of turning the valve by hand.

But how does the regulator know when and how to turn this valve? The operation of the apparatus may be explained as follows: A thin strip of ebonite, which contracts or expands under the slightest change of temperature, is so mounted that any change in its length moves a lever up and down. Meanwhile a jet from the water current already referred to is constantly playing against the moving end of the lever, which really acts as a lid over the jet, hindering its free flow more or less. If the jet is completely stopped, for example, the water backs up in the pipe until the pressure is strong enough to open a little valve, and this little valve sets free a current of water sufficiently strong to work the valve of the steam radiator. This final work is accomplished through a simple piston and cylinder mechanism. Even though the playing jet of water be not completely stopped, but only hindered in the slightest degree, it will set into operation a corresponding degree of power, thus regulating the steam radiator valve just enough to raise or lower the temperature of the room as little as desired.

Whatever use the regulator is put to its main operating mechanism remains the same, while the so-called impulse receiver is adapted to the force or condition which is to be regulated. For steadying temperature the impulse receiver, as we have just explained, is a strip of ebonite. For maintaining an even amount of dampness in a tobacco factory, for example, a band of cotton threads takes the place of the ebonite, and, by contracting or being extended under the changes of humidity, works the lever which hinders the jet of water, etc. For regulating steam pressure in a power plant the impulse receiver is a cylindrical copper bellows which is connected with the steam pipe in which the pressure is to be regulated.

THE FIXATION OF ATMOSPHERIC NITROGEN

Science Service

A NEW process for the fixation of atmospheric nitrogen in a form so it can be used for fertilizers or explosives was explained before the chemical section of the British Association for the Advancement of Science by W. A. Bone, professor of chemical technology, at the Imperial College of Science, London. Nitrogen is naturally a very inert gas and it is difficult to get it into an active state so it will combine with other elements, such as oxygen or hydrogen. In the commercial processes an electric spark or a metallic catalyst is used to get the nitrogen to enter into combination. But Professor Bone finds that nitrogen can be activated by proximity to carbon monoxide in combustion under pressure. Carbon monoxide can easily be procured in quantity from blast furnaces or by passing air through a bed of red hot coal. When this gas is put together with air into a bomb under a pressure of a hundred atmospheres and the mixture exploded, the carbon monoxide unites with the oxygen of the air to form carbon dioxide. But when this combination takes place under such circumstances the heat produced by the combustion is of such a quality as to be absorbed by the nitrogen molecule and set it into such an active state that it will in turn unite with other oxygen molecules of the air. This combination produces oxides of nitrogen from which nitric acids or nitrates of any sort can be readily derived. The nitrogen can be excited by the explosion or mixture of carbon monoxide, and air combines with oxygen more readily than does nitrogen which has been raised to a correspondingly high temperature by exploding a mixture of hydrogen and air.

ITEMS

Science Service

NATIONS with large unmapped areas will be urged to hasten their topographical work so that the resources of the world may be more fully understood, in a proposal which the American Geophysical Union will present before the geenral assembly of the International Geodetic and Geophysical Union at Madrid in October. Geophysical investigations are hampered greatly in countries which have not been mapped topographically. Further international cooperation in determining the configuration of ocean basins will be discussed by the union. A more accurate knowledge of the bottom of the sea is declared the foundation of all future geophysics in the preliminary outline of the discussion.

A NEW method of combating the weeds in California rice-fields has been worked out at the California Experiment Station at Cortena. The old method of irrigation, which consisted in flooding and draining the land at intervals until the rice was well sprouted, permitted the weeds to get a start as well, and like the corn and the cockle in the parable they grew together until the harvest—with the weeds having decidedly the better of the argument. But rice seed will germinate under water, and weeds will not; so the rice growers of the region are now flooding their land to a depth of four to eight inches at the very outset and leaving it that way, with the result that the rice thrives and the weeds perish.

AT least 34 eye defects are hereditary. At least eight of them are apt to produce practical blindness. From 5,000 to 7,500 persons in the United States now are blind from hereditary defects and their care costs more than $2,000,000 a year, it is estimated. These figures are obtained from the report of the committee on hereditary blindness of the American Medical Association, which has studied the subject for the past three years. The committee suggests a legal requirement that persons afflicted with hereditary eye defects be required to give bond at the time of marriage sufficient to cover the cost of caring for possible children who might become burdens on the community.