SCIENCE NEWS

THE FIXATION OF NITROGEN

Science Service

AMERICA now has the most effective method of fixing nitrogen of the air in such a way that it can be used as plant food in fertilizers or in making explosives.

Through scientific work at the Fixed Nitrogen Research Laboratory of the U. S. Department of Agriculture in Washington, a catalytic substance has been developed that brings about the fastest known reactions between hydrogen gas and nitrogen gas to form ammonia.

No formal announcement has yet been made as to the composition of the new catalyst, but Dr. Alfred T. Larson, under whose direction the research work has been carried on, stated to a representative of Science Service that it is made of iron oxide, aluminum oxide and potassium oxide. Since it is composed largely of iron its cost is very low. Methods for large-scale commercial production have been perfected.

The new catalyst is declared to give yields at least twice as high as the best catalysts now known. Through the use of low temperatures and very high pressures, high percentages of the gases are made to combine by this new catalyst. At a pressure of 1,000 atmospheres, 60 per cent. conversion has been obtained. The United States nitrate plant No. 1, at Sheffield, Alabama, was designed for a process that can use this new iron catalyst of superior activity.

Shortly before the beginning of the world war, German chemists perfected the Haber process for the fixation of atmospheric nitrogen, which supplied Germany with nitrates when the usual supplies from the great nitrate beds of Chile were cut off by the blockade. The chemical composition of the catalyst used in the German plants has been jealously guarded as a trade and military secret. Even now American chemists do not know what substances are used in German plants to make the molecules of hydrogen and nitrogen gases get together and make ammonia.

The development of the catalyst used here has been an entirely independent achievement, and according to Dr. F. G. Cottrell, former director of the U. S. Bureau of Mines and now director of the Fixed Nitrogen Laboratory, "As far as we have been able to learn, there is no country in the world which has an ammonia catalyst superior to that developed by this laboratory."

Contrary to policy in every other country, no secret is being made of the results of the research work of government fixed nitrogen chemists. Full details are being given to all who are interested.

Large forces of chemists are understood to be at work in Germany, France and Japan on similar problems and in all cases results are being withheld as trade or military secrets. In Germany, in spite of poor economic conditions, twice as many chemists are at work on this one problem as in the United States. England has a force of 40 to 45 scientists studying atmospheric nitrogen fixation, approximately the same number as is at work here, and Japan spends as much on nitrogen researches as this government does.

Although over 36 per cent. of the nitrogen produced in the world is now supplied by fixation of atmospheric nitrogen, less than one per cent. of America's present requirements are supplied by atmospheric nitrogen fixed within this country. Only one commercial plant, located at Syracuse, N. Y., is operating that uses the synthetic ammonia process, and the catalyst used there is being kept a secret.

The government plant at Muscle Shoals, now idle, has a capacity only one fifth of the 200,000 tons consumed in the United States at the present time. This large plant employs the cyanamide process, which if operated would not utilize catalysts perfected for the synthetic ammonia process.

With no large nitrogen fixation industry in this country, and with 3,000,000 to 4,000,000 tons of nitrogen, equivalent to 150,000,000 to 200,000,000 tons of commercial mixed fertilizers, being lost from land under cultivation and not replaced, the need of intensive nitrogen research to assure adequate nitrogen supplies in the future is declared to be imperative.

PLANT VEINS

Science Service

THE vascular bundles of plants have been found to serve a purpose similar to the nerves of animals, Professor Henry H. Dixon, F. R. S., told an audience at a lecture in Dublin, Ireland. These vascular bundles not only carry raw food material from the roots to the leaves, but also transport the "chemical messengers" which take the place of nerve impulses.

The similarity of distribution of the vascular bundles in plants and that of the nerves in animals was noticed long ago, but as the details of the two systems were worked out differences between the two became accentuated rather than the similarities; now the latter are receiving more attention. In both cases a stimulus given to one part of the body often causes a reaction in a different part. If the tap-root of a plant be artificially deflected from the vertical, a stimulus is set up in a cell just behind the root tip, which results in a bending of the root at that point till it is again growing vertically downwards. Again, when the tip of a grass-seedling is illuminated on one side a stimulus is transmitted thence downwards to the shaded part and causes curvature there.

It has been shown that the stimulus is propagated through some plants at a rate of 10 to 20 millimeters per second. This speed, though slow compared with the velocity of transmission of stimuli along animal nerves, is fast for plants. Scientists are beginning to believe that the stimulus is conveyed by chemical messengers or "hormones" liberated by the stimulated part into the transpiration stream.

In Professor Dixon's words: "Whatever the intimate

mechanism of the system is, the subject of the transmission of stimuli through plant tissues offers a striking example of the swing of the scientific pendulum of scientific opinion. The view based upon superficial resemblances, that the vascular bundles are the nerves of plants, was long abandoned, but now we see there is clear evidence that they actually transmit stimuli from the sensory to the motor regions, and so perform the functions of nerves''; but there are very great differences in detail between the modes of action in the two cases.

THE FOOT AND MOUTH DISEASE

Science Service

THE dread foot-and-mouth disease of cattle has broken out in California. Vigorous action has been taken by the Secretary of Agriculture to prevent its spread to other parts of the country. Trained workers of the Bureau of Animal Industry, experienced in previous epidemics, have been rushed to the scene of the outbreak and a tight quarantine has been clamped on the infected area.

Every effort will be made to prevent a repetition of the spread of the disease in 1914, when in thirty days' time twenty-two states and the District of Columbia became affected. That outbreak was not stamped out until 1916, but this country has been free from the contagion since that time. In Great Britain and most European countries it has gained such a foothold that it is thought that the infection is permanent. In some cases 30 to 40 per cent. of the young cattle die from the infection, although in this country it has not been so fatal, showing a rate of only two or three per cent.

Foot-and-mouth disease is, however, extremely contagious and other animals besides cattle may be affected. Human beings are mildly susceptible to the disease, which may be carried on clothing, farm implements, or other objects which come in contact with the virus from the infected animals.

The germ that causes the disease has never been isolated, but is believed to be one of those which are so small that they pass through the pores of a porcelain filter. The disease usually appears on the back part of the tongue of the animal and between the toes on the feet in the form of small rounded elevations of the skin, from the size of a pin-head to that of a nickel, and containing an amber liquid. When these vesicles break, the liquid carrying the disease germs runs out. The udders of cows also become infected and the infection is sometimes carried into the milk. The virus-containing milk is thought to be the source of the infection of man by the disease.

The quarantine declared by the Secretary of Agriculture covers Alameda, Contra Costa and Solano counties in California, where the disease has made its appearance, prohibits the shipment of cloven-footed animals from the areas, provides for the disinfecting of cattle cars and hay in the quarantined district and requires the sealing of cattle shipments passing through.

How the present infection gained entrance to this country is unknown, but it was first discovered in a large dairy herd near Oakland.

THE TESTING OF BRAKES FOR AUTOMOBILES

Science Service

A NEW, portable device for testing the effectiveness of automobile brakes has been perfected by the U. S. Bureau of Standards. The invention is largely the work of W. S. James, chief of the automotive power section, who had the work in charge. It does away with the need for measured stretches of road, eliminates all the personal factor of the driver, and gives instantaneous results.

The essential principle of the invention is a suspended weight, which, when the brakes are applied and the car slowed down, swings forward, an effect which every one who has ridden in a moving vehicle has noticed when the brakes were strongly applied. In the testing device, the swinging weight is immersed in oil so as to slow down its swing and prevent vibration, and it is connected with a recording pen or pointer which measures the extent of the swing. This in turn measures the retarding power of the brakes.

No calculations are necessary to get the results, at least none by the inspector. With the weight of the swinging weight or pendulum known, the pointer may be made to show just the number of feet in which the car may be stopped when traveling at any given speed, such as 20 miles an hour. If this is known, the distance taken to stop at other speeds may be calculated. The efficiency of the device does not depend on the weight of the car, and since it is only about a foot long and less than that in other dimensions it may be carried about and used in any car.

Results obtained so far indicate a close agreement with observed measurements of the actual distance required to stop cars. In order to eliminate all personal factors, a revolver firing a small charge of red lead was connected with the brake pedal in such a way that when the brake was applied the revolver would be discharged toward the road. The distance from the spot of red to a point directly under the revolver when the car was stopped was then measured.

From these results it also seems that present standards for two-wheel brake effectiveness for the average car are set at impossibly high levels, although they are within the reach of four-wheel brakes, and some two-wheel brakes in first class condition. Balloon tires are slightly more efficient in braking than those of ordinary size, but this is not because of their increased cross section, but because of their lower inflation pressures. They do not cause the wheels to bump off the ground and being in continuous contact with the surface they have a greater drag.

Tests also showed that the greatest braking power was attained just at the point where the wheels started to slide, but while they were still revolving; when sliding at ordinary car speeds the braking effectiveness is reduced. Service brakes were much more efficient than hand brakes as the latter have been designed primarily

only to hold the car stationary when standing on a grade.

The different times required for drivers to obey orders to set their brakes are held by the investigators to make the old-fashioned methods of brake testing quite inaccurate. The average time required was found to be about half a second, or a matter of 15 feet with a car moving at only 20 miles an hour.

SAFETY IN THE COAL MINES

PRACTICALLY 100,000 miners have been trained by the Bureau of Mines in mine-rescue and first-aid methods since the establishment of the bureau in 1910, states Director H. Foster Bain, in his annual report to the Secretary of the Interior for the fiscal year 1922–23. Whereas in 1910 the bureau trained 734 men, during the past year 14,941 men received the training, which was conducted in 35 States and Alaska.

Although the Bureau of Mines can say positively that wide-spread explosions of coal dust no longer should occur, the fact remains that they continue. In 1922 gas and coal-dust explosions took a toll of 311 lives, or 15.78 per cent. of the total deaths. Until the late series of disastrous explosions the lessening number of explosions in recent years had led the bureau to feel that the dangers from this source were being eliminated.

Two effective methods for preventing the spreading through a coal mine of a minor initial explosion have been demonstrated by the bureau at its experimental mine near Pittsburgh, where more than 500 experimental explosions have been produced and in which the explosibility of coal dusts from all parts of the country has been studied. The first method is to wet the dust so thoroughly that no dry dust remains in the mine. The second is to dilute the coal dust with shale dust, limestone dust, or other noninflammable dust so that flame will not pass from point to point.

From its years of study of coal-dust explosions the Bureau of Mines can say that great explosions should not be considered as normal occupational hazards. Explosions can and must be prevented from spreading throughout the underground workings of a mine. Miners and operators, as well as mine inspectors, must take hold of the situation promptly and vigorously or there will be still more serious explosions and more men killed.

The wide-spread attention given to the fatalities from explosions has resulted in the common supposition that gas and coal-dust explosions form the main hazards of mining, but the bureau finds that if the deaths from falls of roof and coal could be eliminated, the number of miners killed would be cut approximately in half. These deaths occur singly or in pairs in the dark recesses of the mine when a slab of slate falls or when coal at the face or in a pillar rolls over and crushes a worker. The deaths from roof falls aggregated 900 during 1922. The fact that this number is less than the total during several preceding years is due to thousands of men having been idle for several months during the bituminous coal strike.

The larger part of the responsibility for decreasing this class of accidents may fairly be placed on the miners themselves. Most of the falls occur at the working places and the miners there are better able to observe the conditions under which they work and to tell when the roof should be taken down or additional props put up than is any one else.

For the 11-year period that ended with 1922, 47.84 per cent. of all fatalities were due to falls of roof and coal, 16.85 per cent. were caused by mine cars and locomotives, 11.25 per cent. by gas and coal-dust explosions, 6.04 per cent. by explosives and 3.47 per cent. by electricity. During this period 25,975 men were killed in coal mines. Approximately 90 per cent. of all the deaths occurred underground, 2.29 per cent. were from shaft accidents, and the remainder, 7.59 per cent., occurred on the surface.

ITEMS

Science Service

THE best January yet for health is the verdict on last month rendered by the statistics of the Metropolitan Life Insurance Company covering their fifteen million industrial policyholders. Nearly every important cause of death registered lower mortality than in the corresponding month of 1923. The tuberculosis death rate, for example, dropped from 116.5 per 100,000 to 107.; that from organic heart disease from 159.7 to 135.9; the Bright's disease mortality fell from 81.9 to 71.4 and the rate for pneumonia from 133.8 to 122.6. Mortality from influenza was less than half that for January of the previous year and there was an appreciable drop in the mortality from diphtheria. For violent deaths, the record is not so favorable. Although lower rates have been recorded so far this year for suicide and homicide, accidental deaths have increased 8 per cent. and automobile fatalities were recorded in January at a rate of 12.9 per 100,000, as compared with 11.0 for the first month of 1923.

THREE new insecticides, two of them chemical and one mechanical, which are expected to be of great aid to farmers and fruit growers in their fight against insect pests, have been developed by the joint forces of the experts on insect fighting of the U. S. Department of Agriculture, of several states, and of the National Canners Association. They are calcium cyanide, nicotine dust and the aphidozer, the latter being the mechanical device, the others chemical. Calcium cyanide is made from lime and the nitrogen of the air and can be produced cheaply in large quantity. Nicotine dust is an application of the old-time tobacco dust, of which nicotine is the active principle. Both of these chemicals have been successful against the common pea-louse or aphid, against which the National Canners Association is waging a determined fight. This insect has given its name to the "aphidozer," a mechanical insecticide. This machine when driven through a field of pea vines sweeps off the troublesome aphids into a container, as much as eleven pounds of the plant lice having been collected from two and a half acres of peas.