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EDITED BY WATSON DAVIS

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EDWIN E. SLOSSON, Director
WATSON DAVIS, Managing Editor

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SYNTHETIC PRODUCTS MAY BREAK NITRATE MONOPOLY

In spite of the fact that ordinary air is four-fifths nitrogen, the United States is at the present time in the clutches of foreign monopolies that control the kind of nitrogen that can be used to feed America's crops, make its explosives, and furnish raw material for thousands of chemical andother industrial plants.

For nitrogen that can be used in industry and agriculture occurs naturally in workable quantities in practically only one location, Chile, and it is expensive and difficult to take the free uncombined nitrogen of the air and convert it into fixed or chemically combined nitrogen that can be used in agriculture and industry. Such American plants as those at Muscle Shoals, using methods developed at home and abroad, can successfully produce American-made nitrates.

Unlike the rubber situation, in which little relief from foreign control is in sight for a decade or more, America can easily become independent of foreign nitrate in time of need.

American crops and factories use nearly $75,000,000 worth of nitrogen in one form or another each year, and over $50,000,000 of this comes from abroad, chiefly from Chile. Other kinds come as fertilizer from factory wastes or as ammonialiquors from coal distillation in the making of gas coke. The rest is made synthetically from the nitrogen in the air by chemical means.

In 1925 the world used 857,000 tons of the element nitrogen, exclusive of that occurring in animal products of foods. Of this amount 44 per cent. comprised the nitrogen in the output of Chile saltpeter, and 56 per cent, was fixed nitrogen.

A monopoly of nitrate producers controls practically the entire output of the Chilean fields. The government of Chile is a party to the monopoly and puts a tax of $12.34 on every ton of nitrate that leaves the country. At present, the price of the nitrate, artifically boosted by the tax, sets the standard for all synthetic nitrates and fertilizers.

It is believed that when the methods for getting nitrogen from the air are further improved and more commonly used, synthetic nitrogen products will turn the tables on the Chilean fields. Recently discovered means of getting nitrogen from the air where it exists in unlimited quantities and in an clusive form, have become of vital importance in peace and war. By these means Germany freed herself from Chile before the war, and the United States might do the same.

As a result of nitrogen fixation it is estimated that 56 per cent. of the world's supply of inorganic nitrogen came out of the air in 1925. Before the war only 10 per cent. was gotten in that way. The plentiful supply of nitrogen which is in the air and there for the taking, may make it possible for agriculture of the future to meet the demands of the fast growing population of the world, which is disturbing the sleep of many an earnest economist. There is almost unlimited room for improvement in agriculture. The Department of Agriculture points out that in 1925, out of the forty odd millions of acres planted in cotton, only about 36 per cent. are fertilized.

"What is done with the nitrogen problem in the next ten years will go far to determine American standards of living,"according to a statement of Dr. Harry A. Curtis, former chief of the nitrate division of the U. S. Department of Commerce. "Unless relatively cheap fixed nitrogen can be supplied to agriculture each acre will produce smaller crops while our population will continue to get larger."

Although the processes for getting nitrogen from the air are less than twenty years old they already give the world each year an amount greater than that shipped out of the Chilean fields. There are manypossible ways of hooking up the obdurate atmospheric nitrogen with materials on earth, but only three of these ways are actually used.

The simplest of these is the electric are process. Nitrogen is induced to combine with oxygen by the powerful stimulant of electricity. The nitric oxide formed is passed through huge absorption towers where it reacts with water and more oxygen to form dilute nitric acid. The process has been successful in Norway, but the exceedingly high electric power requirement has prevented its use in most other countries.

In the cyanamide process, which was first used in Italy, nitrogen is trapped as it passes over finely powdered calcium carbide heated to about 1000 degrees. It becomes chemically fixed into solid calcium cyanamide which can be easily changed to ammonia gas or nitric acid. The raw materials needed for making the calcium carbide are coal and limestone, and the energy required is only about one-fourth that needed for the arc process.

It was found that calcium cyanamide could be put directly into the soil as a fertilizer. This stimulated production, and in 1913 there were already nine producing countries making 172,000 tons of the substance. The production is about four times as great today.

The synthetic ammonia process, the newest of the three methods of nitrogen fixation, was not known outside of Germany when the world war began. Today, however, there are many processes based on the same principle. The pioneer Haber process was worked out mostly by Fritz Haber in Germany between 1905 and 1908. The principle involved has been alluded to as the most far-reaching accomplishment of chemical engineering.

The general features of the German patent were publicly known, but the intimate details that made it workable were secret. The American government, fearful of being cut off from Chile, set up a plant at Muscle Shoals, Alabama, to operate a modified method worked out in the United States, but did not get it into operation until the war was over. British attempts to establish synthetic ammonia plants were also unsuccessful.

After the war a number of countries set to work in desperation to solve the problem. In 1921 a way that worked was found at a plant in Syracuse, New York. Plants of various countries are now able to produce over 300,000 tons of fixed nitrogen each year, but the capacity of Germany's plants alone accounts for over 90 per cent. of the total.

This process sounds as simple on paper as any of the others but it was the hardest nut to crack. A properly proportioned mixture of nitrogen and hydrogen gas is passed over a catalyst, a substance that by some seemingly magic influence can make two unwilling elements react chemically toward one another. The combination forms ammonia. Heat is produced, and not absorbed, during this reaction and the more the temperature is kept down and the pressure up the more ammonia is evolved. A difficulty of this process is to obtain pure hydrogen and nitrogen, for impurities lessen the efficiency.

"The synthetic ammonia process is much better suited to American conditions than the arc or the "cyanamide process," Dr. J. M. Braham of the U. S. Fixed Nitrogen Research Laboratory has stated. "There are in this country enormous potential sources of hydrogen. The power requirements are small and the process does not require a large amount of labor."

NEW MACHINE SENDS CODE MESSAGES AUTOMATICALLY

If the code message in Edgar Allan Poe's famous story "The Gold Bug" had been written on the machine described recently to the American Institute of Electrical Engineers, Legrand, would not have had such an easy time deciphering it, for the age-old search for a method of putting important messages into a code which cannot be interpreted without the use of the key seems to have been achieved.

The new machine was described by G. S. Vernam, engineer of the American Telegraph and Telephone Company, who stated that it had beendeveloped for the use of the Signal Corps of the U. S. Army during the war, but until recently it has been kept secret. However, one of the advantages of the device is that even an unauthorized person who has full knowledge of the methods and apparatus used can not interpret the message without the key.

In use, the sender writes the message on a keyboard similar to that of a typewriter, and a perforated tape results which can be used in tape transmitters frequently used in telegraph offices. By means of another kind of machine, if it is desired, the cipher message can be written directly in five letter code words on paper in ordinary characters. When the message is received, it is written on a tape in perforations, and when this is passed through the deciphering machine, the message is written out in plain text on a sheet of paper.

The method used is one involving what is referred to as a multiple alphabet substitution cipher. In the ordinary substitution cipher a cipher alphabet with the letters arranged inan arbitrary manner replaces the actual alphabet in the same order. That is,instead of starting A,B,C, etc., the cipher alphabet might start F,Q,R, etc., and in use, the letter A in the original message would become F in the cipher; B would become Q,, and so on. Such a cipher may easily be interpreted in the way Poe made famous in "The Gold Bug", by noting the letter that occurs oftenest and calling it E, which is most used in the English language.