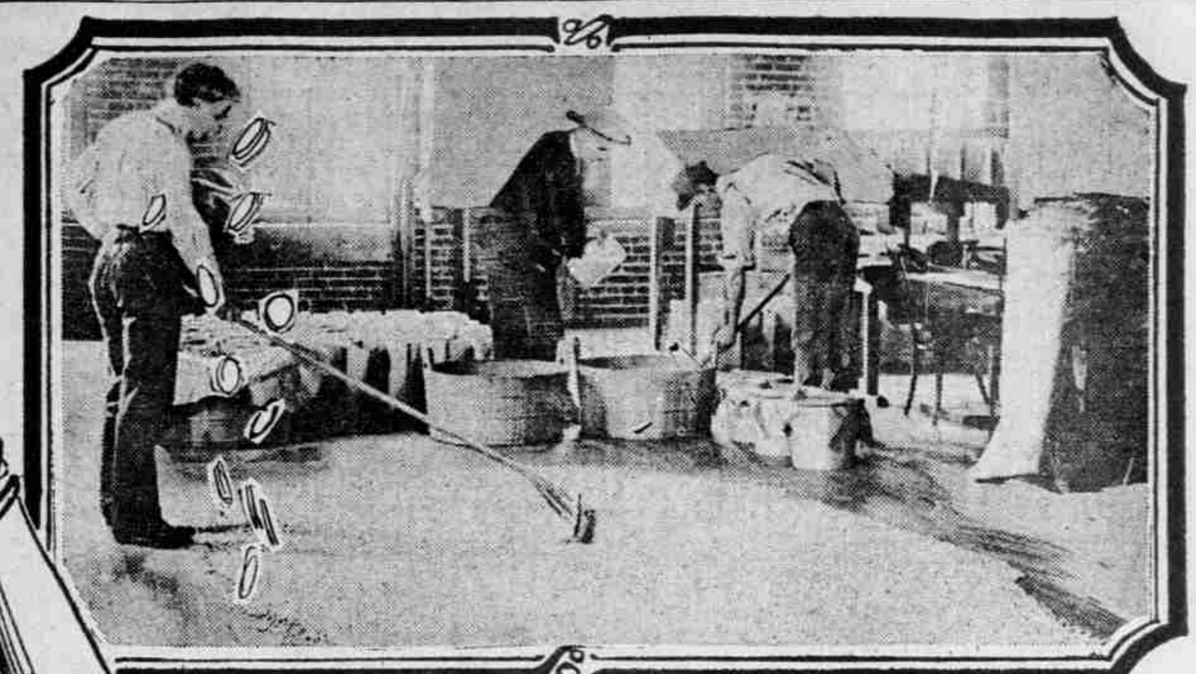
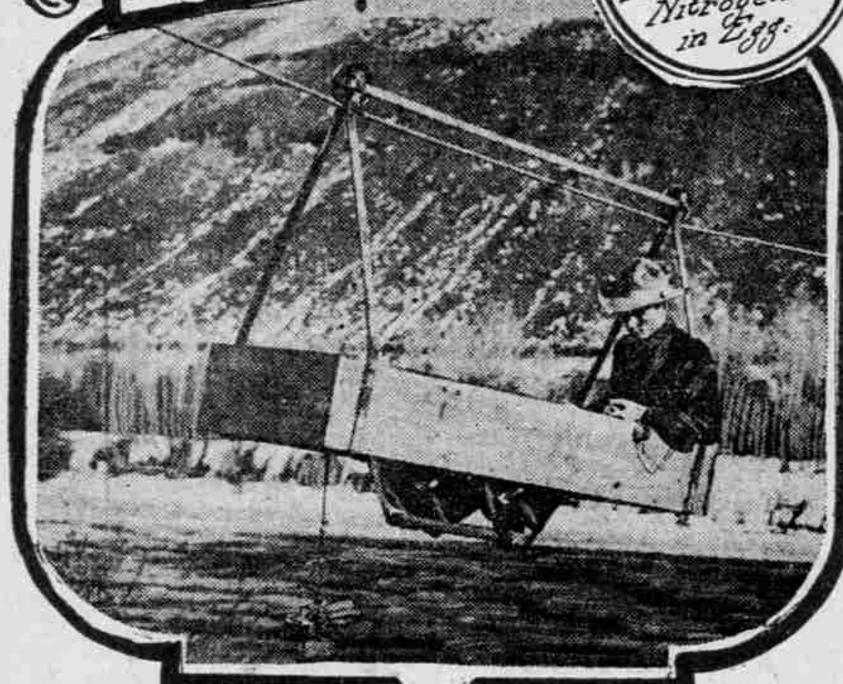
# There's Wealth in the Very Air You Breathe

## Reduce it to Nitrogen and Fortunes Await You. How it is Done in Norway.

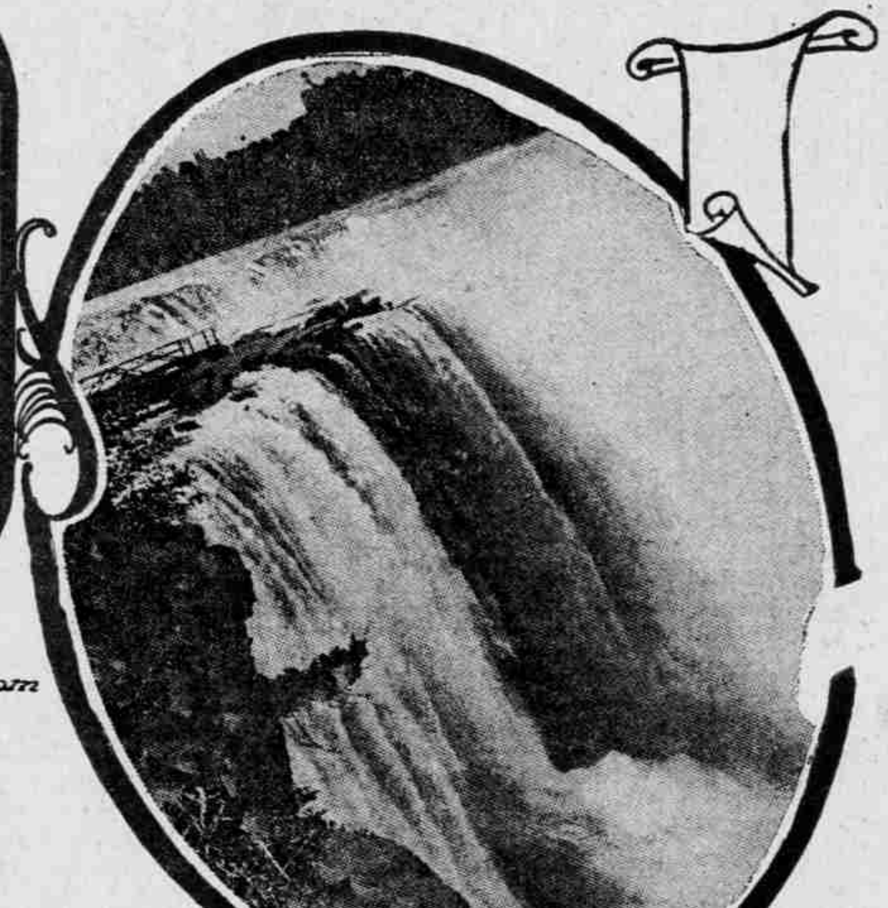


Mixing Culture of Nitrogen-Making Bacteria With Peat for Seed

Fluid in Bottle Represents Amount of Nitrogen in Egg.

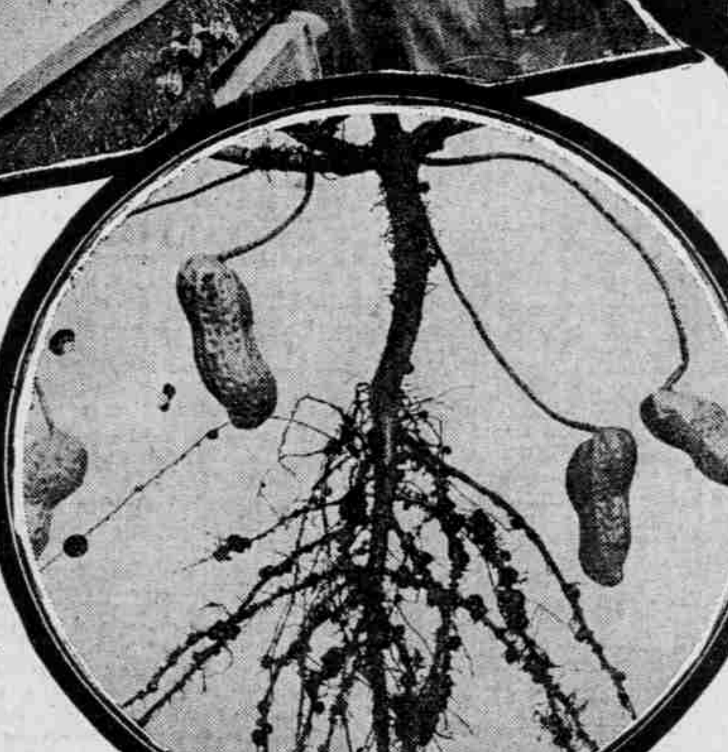


Measuring a River's Rate of Flow. Every Stream is a Possible Maker of Nitrogen.



Niagara Falls Could Furnish all the Nitrogen This Country Needs

Bottling Nitrogen



Nodules Containing Nitrogen-Gathering Bacteria on Peanut Roots

WHY should we not manufacture our own nitrogen in this country?

The need of it is becoming urgent—so much so that general attention has at last been awakened to the importance of finding a means whereby this substance, so indispensable to agriculture, may be procured from atmospheric air.

The thing is already being done on a commercial scale in Europe, where nitrogen, separated from air by the "electro-magnetic blast," is supplied for industrial purposes at a fraction of a cent a pound.

Imagine an electric flame with the shape of a disk, almost inconceivably thin, and yet of a temperature so enormously high as to approach the celestial. Suppose it to burn in a fire-brick-lined furnace of steel, through which large volumes of air are forced. The intense heat compels some of the nitrogen in the air to enter into chemical combination with some of the oxygen, forming nitric acid. Then the air containing this nitric acid is passed through a lime solution, to make nitrate of lime, which, when dried, is ready for use as a fertilizer.

This is the method adopted abroad. There is no reason why we should not manufacture nitrogen in the same way in this country, the only requisite being plenty of waterpower to make cheap electricity. At Niagara Falls enough nitrogen could be produced to meet our requirements, for agricultural and other purposes, for all time to come.

Lacking such a resource, our farmers are obliged to buy nitrogen, imported from Chile, at something like $60 a ton, in the form of nitrate of soda—a compound less available for their use than the artificial nitrate of lime, for the reason that soda is worse than useless as a fertilizer, more than a very moderate amount of it being a positive hindrance to plant growth.

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If this country is to be able in the future to support a greatly augmented population, nitrogen must be had in quantity practically unlimited to maintain the fertility of the soil. For our supplies of it, unfortunately, we are now obliged to depend almost entirely upon foreign sources.

It is provoking, under the circumstances, to consider that nitrogen is one of the most plentiful substances in Nature. "Directly above every acre of farming land there are 33,880 tons of it," says Professor Charles E. Munroe, eminent chemist, and one of the foremost living authorities on this subject. "More than three-fourths of the gaseous mixture that composes the atmosphere is free nitrogen." It is a colorless, tasteless, odorless gas, and, so far as its usefulness for breathing is concerned, it seems to answer no other purpose than to dilute the oxygen of the air, which in a pure state would be too strong."

Above any square mile of the earth's surface are nearly 22,000,000 tons of nitrogen—enough to supply the needs of the world for the next 50 years, at the present rate of consumption. The total of the stuff held aloft in the atmosphere is not less than 500,000 times as much as is in actual use by the vegetable and animal kingdoms.

Because the air is without color and so fluid, we fail to realize how dense it is. A cubic foot of it, at sea level, weighs over an ounce—which means that a cubic mile of it would weigh more than 5,000,000 tons. No wonder that "ships," properly patterned, are able to float in it, or that its movements, when sufficiently rapid, uproot forests and overthrow strong buildings.

But see! A "thunderbolt" passes through this atmospheric ocean. The air immediately surrounding its path is raised to so high a temperature as to become actually incandescent, and we say, "Behold the lightning!" An incidental circumstance, of which we take no note, is that the electrical discharge causes some of the nitrogen in the air to combine with some of the oxygen, forming nitric acid. Thus it happens that small quantities of nitric acid are found in the raindrops of the succeeding shower.

The means adopted for making artificial nitrogen, curiously enough, is an imitation of this process. When an electric arc, produced by a current of high intensity, passes between two copper electrodes while exposed to the action of powerful magnets, it spreads out into the form of a flaming disk. The disk seems to burn steadily and continuously, but in reality it is constantly disappearing and renewing itself again—as often, it may be, as 1000 times a second.

This is what is called the "electro-magnetic blast." When volumes of air are forced by fans into contact with the intensely hot flame, nitric acid is formed, which may then be separated out in a pure state, or utilized through various processes for the production of nitrate of lime, nitrate of ammonia, and other compounds utilizable in agricultre or in the chemical arts.

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The first industrially successful process for transforming the air into a commercial product was devised by Christian Birkeland, a professor of physics in the University of Christiania (Norway), and Samuel Eyde, a Norwegian engineer. They began ten years ago with a small factory plant, using only 150 horsepower, near Christiania.

Since then the industry has enormously expanded, and the principal plant, at Notodden (Norway), operates a series of 32 electric furnaces, through which 35,000 cubic feet of air are forced every minute. One thing that excites the attention of a visitor at the works is that the immense factory has no chimneys—this for the reason that no fuel is used, all the power being obtained from the two neighboring waterfalls of Lienfos and Svaelgfos. Another thing noticed is a sharp and continuous rattling sound, which is due to the incessant breaking of the electric arcs. The temperature of the arcs is over 5400 degrees Farenheit—sufficiently high to melt any substance known in nature.

The air escaping from the furnaces, through outlets provided for the purpose, is chilled in coolers consisting of great numbers of aluminum tubes over which cold water runs. Subsequent processes separate the nitric acid out of it, or utilize the latter to form various compounds, such as nitrate of soda, nitrate of lime, or nitrate of ammonia. These nitrates are finally evaporated and ground to powder, which is dumped into casks, ready for the market.

The nitrogen factories in Norway are now sending many thousands of tons of nitrate of lime annually to California and Hawaii, to fertilize the fruit orchards and sugar plantations. The demand for the product is steadily growing, and Norwegian nitrate is competing successfully in the market with "saltpeter" from Chile.

All animal and vegetable life depends on nitrogen. It is the most essential element of the stuff in our foods which goes to make flesh and blood. The body of an average man contains nearly four pounds of nitrogen. With the tissues of plants it passes into the bodies of animals, whence it returns to the soil.

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Nitrogen supply is one of the pressing economic problems of the 20th century. Consumption of its compounds (chiefly saltpeter from Chile) has already reached enormous figures, and is growing at a steadily increasing rate.

The people of the United States are now paying over $32,000,000 per annum for imported nitrogen, more than half of it coming from Chile, where the deposits are already so near to exhaustion that it is not expected they will last more than [illegible] years longer.

As population increases the necessity for liberal use of nitrogen as a fertilizer will become more and more imperative throughout all parts of this country. It is estimated that about one-third of an acre of wheat per annum is required to furnish bread for each person, and, the area suitable for the proper production of cereals being, limited, it is a question how the hundreds of millions of future Americans are to be fed. But with plenty of nitrogen supplied, the danger line of possible bread starvation will not be approached until far into the twenty-first century.

In addition to the demands of agriculture, modern chemical industry calls for vast amounts of nitrogen and compounds of nitrogen. One-fifth of the Chile product in Europe goes into explosives, coal-tar colors and other manufactures of chemistry.

The Chile saltpeter (nitrate of soda) is found along a narrow strip of desert between the Pacific Coast and foothills of the Andes. It extends for a distance of some hundreds of miles through a region where there is no rainfall and no vegetation. The theory now generally accepted is that the area in question was originally below sea level. As it was gradually elevated, through a process of geologic change, enormous quantities of seaweeds collected, and eventually a vast mass of such marine vegetation, decaying, left behind a deposit of soda salts containing about 13 per cent of nitrogen.

Today the deposit forms a stratum not on top, but just beneath the surface, from a few inches to 16 feet in thickness. It has brought wealth to Chile, the rest of the world having paid more than $425,000,000 during the last 33 years for nitrate derived from this source.

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Guano, so valuable for the phosphoric acid it contains, has also from 12 to 14 per cent of nitrogen. The chief sources of supply are various islands and precipitious coasts of America, Africa and Oceania. Unfortunately, the deposits, representing the accumulation of ages, have been drawn upon to such an extent that what remains of them cannot last much longer—though the Peruvian government has taken measures to protect bird life on its islands, and so to insure a continuance of the supply. From Peru over 11,000,000 tons of guano have been exported in the last 70 years. A great deposit was discovered only recently on an island opposite Campeche (Mexico), estimated at 10,000,000 tons, and an American company has the concession to work it.

But it is manifest that all natural sources of nitrogen compounds are rapidly approaching exhaustion. It is absolutely necessary that the indispensable material shall be obtained in some other way, and the only imaginable means of getting it is to separate it from atmospheric air.

This industry was first developed in Norway because of the exceptional opportunities there for obtaining water power for the production of electricity. Fortunately, in the United States there is plenty of water power to be had, and before long necessity will compel us to employ it on an extensive scale for the production of nitrogen, thus rendering us independent of foreign sources of supply.

RENE BACHE.