MAKING THE AIR FEED US

How a Woman Has Forced It to Pay Man's Debt to Mother Earth

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TO make the wind that from Eden time bloweth where it listeth carry man on frail new found wings savors of the sublime.

But it also savors of the supremely natural, for have not the years looked forward to it as a foregone conclusion? Not because it was imperative, like those problems that the race must solve for its very existence, but merely for the reason that man in his godlike vanity must perforce reach the very limit, if limit there be, of his possibilities. So men have learned to make wings that adapt themselves in a measure to the air, and when the untamable winds are complaisant they make their little flights and say, "We have conquered the sky. Behold the sublime!—the work of men." And the name of each aerial adventurer is known and lauded and passed from tongue to tongue.

To take that same free eternal air and rend it as we rend the earth to make metals, to make of it helpless material in men's hands, answering with indifference its raging and blustering, and to do not only that, but to make it answer the most unanswerable riddle ever propounded by Mother Earth—this is the work of one woman. And it is a thousand to one you have never even heard her name.

No, not strange, but only the world's way. For one achievement is as romantic and gratuitous as a tourney of knights in glittering armor. But the other is as humble as the baking of a loaf in the ashes. So that I hesitate to turn from the grandeur of flying through the air to the musing of fertilizer from that air, lest I be accused of wilfully plunging from the sublime to the ridiculous. And not only the ridiculous, but the impossible.

Never heard of making fertilizer out of the air? There is a factory now doing it at Niagara, the demand for whose product is so great that last year it increased its output by several hundred per cent. Another such factory is being built in South Carolina; there are seven or eight in Norway, paying twenty-five per cent dividends, and Sweden, Austria, Germany and France have them also.

Moreover, now that this method of making out of an exhaustless supply, free to all, something that is absolutely essential to your life has been made practicable, these factories will soon be so common that you won't stop to read about them.

But why do it, say you, when all we need to pay earth for what we take from her is the waste that we must be rid of anyway? And why talk about it in terms of drama?

Because it is drama, enacted by characters mystical, gigantic, primal. We find in the first act Mother Earth conspiring against her children with plot as malevolent as any that weighted the Greek tragedies. She propounds a riddle that one must answer or all must die. Then enter sage and scientist and the wise of the world to conquer her with the might of wisdom, and their wisdom answers the riddle no more than the babbling of children.

Expressed in terms, not of their primal significance, but of modern economics and commerce, the facts stand thus:—Fertilizer is absolutely essential to your life because there is not so very much virgin soil left on the earth and much of what there is is uncultivable. And in spite of the rotating of crops earth is becoming weary with the immense strain of feeding her teeming millions. In the childhood of the race she fed us freely, as a mother should her babes. But as the race grew up things have changed, and earth long since became like a bank into which we must first put something if we would get anything out. The next age will behold a still more stringent state of affairs, for earth will be seen to be holding over man's head a mortgage, with the threat of immediate foreclosure if the giant interest accruing be not met. Even now things have reached a state where practically every acre of land under cultivation is first fertilized. Take the cotton crop as a single instance. In the South last year three million tons of fertilizer were used for its production alone. That was drama enough, but the climax is that the end of the natural fertilizer is in sight. Which means that Mother Earth has at last seen through our trick of paying our board bill with something taken from herself and is putting a lock on the pantry door.

What next? We must pay her or starve, and pay her in advance in the shape of so much fertilizer for so much food. So the grand question becomes, "How shall we pay without coin? Earth is our only supply of food. And now she is withdrawing the coin."

Could a more impossible deadlock be imagined?

And doesn't the deadlock become a thing to amaze the stars when we consider that one of the most needed elements of a "complete fertilizer" exists right in the air that all plants grow up in and breathe and stretch out their arms in but that through all the aeons that have passed since "God said, let the earth bring forth," they have been separated by a gulf from that food that they live in and for lack of which earth says she will one day extinguish them and through them us.

That is not to say that plants do not absorb nitrogen from the atmosphere. But plants obtain but a part of the needed nitrates that way. The rest must, by an edict of nature, come by way of their roots from the soil where earth is withdrawing the supply, instead of by way of leaf and branch from the air, where the supply is exhaustless.

Doesn't that look as if it were true that earth were conspiring against her children? That is just what it has been doing ever since those keen eyed scientists who are able to peer into the future and see the end of those supplies that seem so boundless to the lay mind. But even to them the question has only recently become acute, and they have been asking each other for a this great Sphinx riddle could be answered.

But where was ever the woman who could forever remain a closed book to other women? The riddle has been answered, and answered by a woman. Mother Earth demands fertilization and is withdrawing her own natural supplies of the coin she demands, what then? "Simple," said one thing besides the earth available, and that is the air. Use it." And then she devised the method of extracting the nitrogen from the air and using it to make nitric acid, and in turn the multitudinous chemicals that man now needs, including the humble and all-important fertilizer.

"When did she do it?" asks the public. "It must be very recent or the news would have travelled outside of scientific circles. When it does, the woman will be lauded as she deserves."

The woman will not be lauded. She made her discovery more than half a century ago, taking out an English patent on the process in the year 1859, and the decades that intervened between the time of her work and mankind's discovery of its necessity have been sufficient to bury her name as completely as they did her deed till urgent necessity made us aware of it. Look through the articles on famous women scientists in the old French revues, look through French dictionaries of science and histories of important inventions. You'll find the names of those who met a then recognized need, but you will probably find no mention of her, though the value of her discovery may exceed theirs many times. And listen to this, published not long ago in one of the chemical trade journals:—"Nitrogen * * * is so rare an article, the commercial sources of it being so few, that he who will discover a cheap commercial process for obtaining it from the atmosphere and combining it in a form that will be serviceable in crop production not only will be a great benefactor and inventor, but will change the economy of living on this earth."

"He who will discover!" "She" had already discovered, and had done it before the need became pressing, just as a mother feeds her family so long before hunger becomes acute that they are not aware that her simple act sustains and saves their very lives. Had Mme. Lefebre made her discovery fifty years after she did this is what that chemist would have said:—"Nitrogen * * * is so rare an article * * * that she who has discovered a process for obtaining it from the atmosphere * * * not only is a great benefactor and inventor, but has changed the economy of living on this earth." Then he might have added:—"And the modern need being everlastingly for the greater cheapening of processes, and the cost of her invention being practically the cost of water power, high or low, the one who will make the latter still cheaper or invent a substitute independent of the natural supply of water power, will make her blessing to mankind practically free."

What is this process that produces such marvellous results? It is as elemental in its simplicity as the great primal drama I spoke of in beginning to tell this story. It is in this that fire and water are called in to aid the woman. Fire? The leading feature of the process is an electric arc between the poles of which the temperature is 4,000 degrees centigrade, or 7,502 degrees Fahrenheit. It reminds us of that "fervent heat" in which "the earth also shall melt," and when air is passed over that arc one naturally expects a result apocalyptic in its nature. What does happen is that the oxygen in the air is burnt up, utterly consumed. That which remains is a colorless gas, as invisible as the air itself, which is known as nitric oxide. This, driven out into the air, recombines with it, the result being, of course, twice as much nitrogen as there was before to the same amount of oxygen; in other words, nitrogen dioxide (NO_2). The next step is just as childishly simple. There is added one more ingredient, no rare and mystic compound to transform the air by magic into chemicals before our eyes—just water. The result of this is nitric acid, poisonous and powerful, made of air plus a part of the air plus water! And this chemical stands second in commercial importance, only one, sulphuric acid, having a vaster area of usefulness.

But nitric acid, you say, is not fertilizer. It practically is in the chemist's mind, for with it he is as near to having fertilizer as he is to having money when he pushes an indorsed check through the paying teller's window. Limestone is cheap, exhaustless, easy to get and easy to work. He treats it with his air made nitric acid, and the result is nitrate of lime (or nitrate of calcium), for fertilizing purposes the practical equivalent of the famous Chilian nitrate of soda.

That is about all of the process, but simple as it is, it is spectacular enough to fulfil all expectations. For the electric spark between the poles of that arc is nine feet long. Nine feet of that inconceivable fervor of heat!—a nine foot core of light so intense as to be colorless—a thing almost beyond the concept of both eye and imagination. Surrounding this is a zone of a wonderful greenish blue, fascinating and repelling at the same time, like an evil beauty. Here the temperature is 1,400 degrees centigrade, or 2,552 degrees Fahrenheit. Wrapped about this (the beauty's veil, to make more alluring by partial concealment) is a zone of pale greenish brown, and here the temperature is but a paltry 900 or 1,000 centigrade. It is mystical, terrible, and to behold as its result that humble, whitish, crumbly stuff that is only fertilizer dust, and to return to dust, is as if we were to behold witches casting with spells and mutterings, all sorts of magic into their cauldron to take there from—a loaf of bread.

That is just what it is, though—bread for us and the generations to come. For, in spite of the fact that water power costs four times as much in this country as it does in Norway and twice as much as in Austria or Switzerland, its development has already so cheapened the use of electricity that the production of atmospheric nitrogen is at last coming into its own as a thing of such limitless commercial value that its discoverer indeed deserves the name of "a great benefactor," for she has, in truth, accomplished that which will "change the economy of living on this earth."

Change the economy of living? Well, yes. Consider this; Chili has our greatest supply of nitrates and from Chili they are now taking two million tons of the stuff a year. At that rate one could conceive of the land of Chili itself being done away with before long, and can easily believe Sir William Ramsay, the great scientist, when he says that in one hundred years, a time long to the lay mind, but short to the scientist, this great bed will be exhausted. With that in mind we can see why we have received a blessing from the woman who made it possible to make the all essential nitrates from the exhaustless air at the rate of one million tons of the chemical from the air over five acres of land. When earth began demanding such wholesale fertilization the supply seemed limitless. At first just the various sorts of waste met it. But as earth began crying "More, more!" such things became but a drop in the ocean to what is needed. Of phosphate and potash there seem to be limitless supplies, nitrogen, phosphate and potash being the three elements of a "complete fertilizer." It was the great Liebig who discovered that these three elements are necessary and he uttered the famous words, "That man is a benefactor to his race who makes two blades of grass to grow where but one grew before." But even he merely stated the principle that the three are needed and that no two of them will unlock Mother Earth's closed pantry door. There must be the third, and when men had searched the earth in vain for it a woman took it—out of the air.

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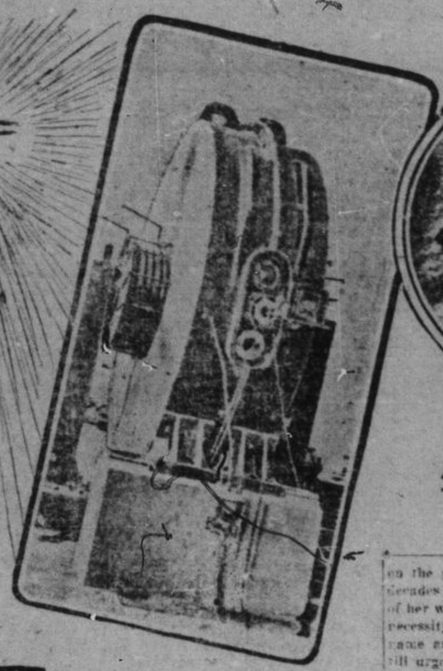
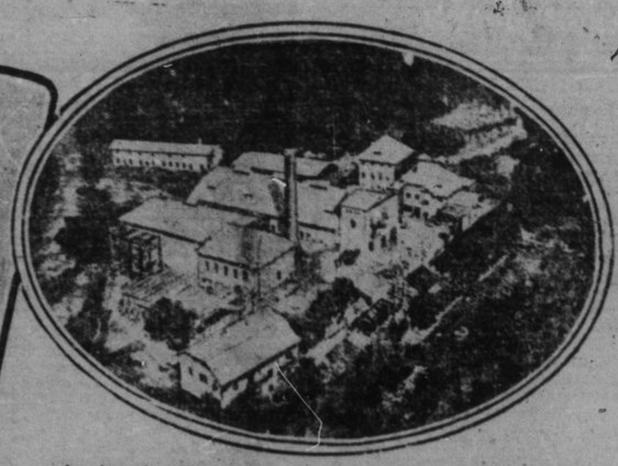


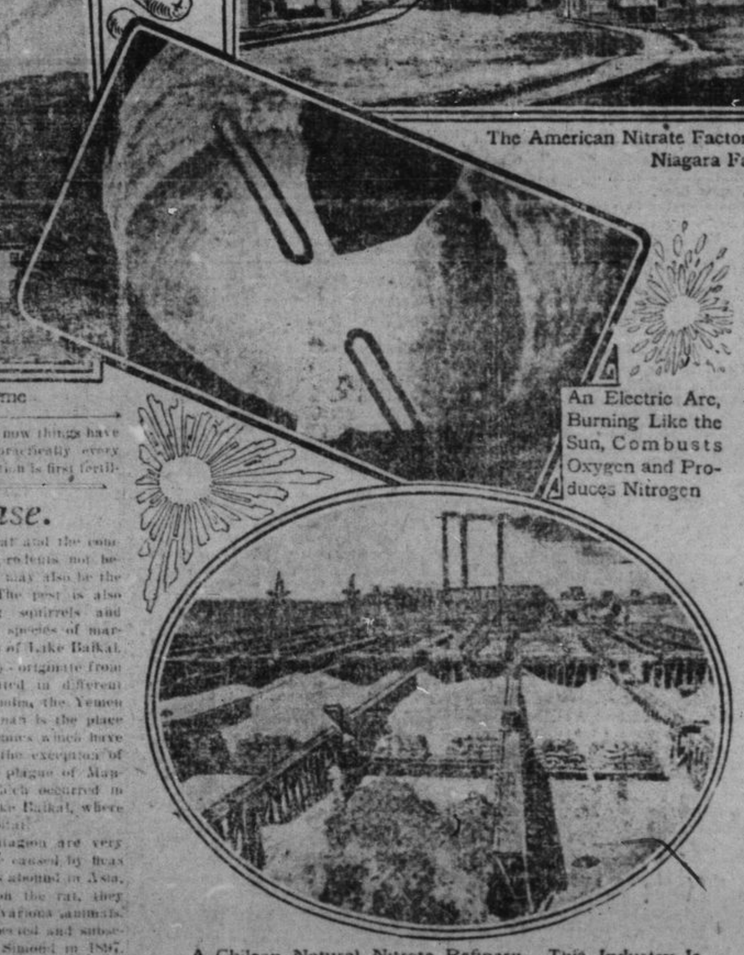
A Norwegian Electric Furnace for Producing Nitrate



An Austrian Nitrate Factory Using Water Power in the Tyrol. A Tremendous Explosion Recently Totally Destroyed This Establishment

The American Nitrate Factory Using Water Power of Niagara Falls

French Nitrate Factory at La Roche de Rame



An Electric Arc, Burning Like the Sun, Combusts Oxygen and Produces Nitrogen

A Chilean Natural Nitrate Refinery—This Industry Is Threatened by the Artificial Nitrate Factories

The Rats Role in Transmitting Disease.

WHETHER as transmitter of disease or as a simple agent of destruction, the rat is an animal which must be destroyed at the cost of any effort. In a very interesting work published under the title, "La Lutte contre le Rat," Dr. Lagarrigue has described at great length the various means which have proved most successful for this purpose up to the present. The measures recommended by him as indicated subsequently are justified by the misdeeds imputable to these rodents.

The term "rat" comprises in reality various species of rodents belonging to the family of muridae, the principal being the brown Norway rat, the black rat, the common mouse, the field mouse and the field mole.

The brown Norway rat is now very common almost everywhere. It came originally from India and Persia, and seems to have appeared in Europe first about the middle of the seventeenth century. It has spread all over the world, its diffusion being favored by the extension of commerce. This rat lives in sewers, cellars, granaries and warehouses. It is an excellent swimmer, burrower and climber, adapting itself admirably to varied circumstances and is very apt to penetrate into the holds of sea-going vessels. These rats, with two or three litters a year of four to a dozen young in each, multiply extremely fast. The brown rat is readily recognized by its size (thirty centimetres), by the slightly tawny color on its back and the gray color below, by its tail, thick at the base but shorter (twenty centimetres) than the body; by its feet with the claws united at the base by a slight interdigital membrane.

The black rat has a thin tail, which is longer by five centimetres than the body (fifteen centimetres), its claws are devoid of any membrane, while its coat is ordinarily black on the back and gray below. One variety is known which is white below. It is found to some extent in all parts of Europe, and is particularly common in Egypt. The black rat gradually disappeared from towns on the appearance of the brown Norway rat, which is much more ferocious and prolific.

The common house mouse has a body nine centimetres long, the same length as the tail—and is of a grayish brown color on the back, of a lighter shade on the sides and of an ashy color below. Mice have three to four litters a year, with six to eight young in each. This species is met with everywhere, and will make a home in the slightest shelter.

The field mouse is twelve centimetres long. Its tail is about the same length. Its coat is tawny above and white below, these two colors being distinctly separate on the sides. The feet are white and show a dark brown or tawny colored spot. The field mouse is common everywhere in the country. It burrows in the ground, attacks field crops, birds and their eggs, while it also gnaws the bark of saplings. It is just as prolific as the domestic variety.

The harvest mouse is a smaller variety (five to six centimetres). It is tawny on the back, white below and on the feet. It feeds on grain and insects and builds a nest on low branches or in bushes from interwoven hay or grass.

The field mole has a tawny coat with a gray tinge and is white below as well as on the feet. The body is ten centimetres long and the tail five centimetres. It commits enormous ravages in cultivated plains. In the summer it burrows in the fields and in winter retreats to barns.

Although it is still doubtful whether rats may transmit hydrophobia and auxiliary fever, it is incontestable that they are guilty of transmitting the bubonic pest. From the most remote times the presence of rats during plague epidemics has attracted the attention of observers. At the present day in Yunnan bubonic plague is known as the "rat disease."

Dr. Yersin, after discovering the microbe of the bubonic pest, observed during the Hong Kong epidemic in 1894 that in the infected quarters numerous rats were lying dead on the ground and that almost all contained great numbers of the pest microbe in their organs. In 1898 Dr. Simond gave a convincing demonstration of the fact that rats transmit plague. After studying the epidemics in India in 1896, 1897 and 1898, Dr. Koch, in 1901, defined the plague as a disease of rats, in which man participated. Dr. Borrel, in 1902, made a thorough study of the propagation of plague from Eastern countries to Europe on board ship, all the ports of call being successively contaminated by pestiferous rats.

These facts have been so frequently verified that they are now definitely accepted. The rats affected by the plague are, in order of frequency, the brown Norway rat, the black rat and the common house, and will make a non house. But other rodents not belonging to the rat family may also be the cause of the plague. The pest is also rather frequent among squirrels and among the tarbagans, a species of marmots found on the shores of Lake Baikal.

Plague epidemics always originate from the same centres, situated in different parts of the globe—in India, the Yemen and in Kurdistan. Yunnan is the place of origin of all the epidemics which have raged since 1894, with the exception of the last, the pulmonary plague of Manchuria, the origin of which occurred in the regions adjoining Lake Baikal, where the tarbagan has its habitat.

Cases of imported contagion are very interesting, for these are caused by fleas as intermediaries. Fleas abound in Asia, and, though parasites on the rat, they readily bite man and various animals. This fact was first suspected and subsequently proved by Dr. Simond in 1897. It was definitely corroborated by the British commission in India. The latter body showed that a flea's stomach, with a capacity of half a cubic millimetre, may contain five thousand microbes when full of the blood of pestiferous rat.

The following experiment has shown that healthy rats placed in a cage with infected rats and fed the remainder in perfect health if all the animals were covered personally free from fleas. If fleas were introduced, however, they contracted the disease with a percentage of losses in direct proportion to the number of insects. On placing infected rats in cages sufficiently far from other cages containing healthy rats so that the fleas could not jump across, the space the healthy rats did not contract infection. But if the cages were brought within a few centimetres of one another infection occurred.

Fleas may thus play a principal role in the transmission of the plague, while rats, beavers or squirrels may constitute reserves of the virus. Prophylactic measures for arresting the plague must therefore be directed toward destroying these two categories of animals. In exterminating the rats provision must be made for destroying the fleas, a condition which is not fulfilled by the ordinary means of poison or traps, but which is satisfactorily effected by the use of sulphurous anhydride, carbon disulphide or hydrocyanic acid.

ABOUT AMBERGRIS.

A PRESS report from Victoria, B. C., the other day stated that a piece of ambergris estimated to be worth $150,000 was taken from a whale killed by the whaler Pretriana, which arrived at that port July 5. This is said to be one of the largest pieces of ambergris ever found.

Ambergris is supposed to be a morbid secretion of the liver of the spermaceti whale, found floating or washed ashore. It is a little lighter than water, and might easily be taken for a piece of the bark of a tree. On examination, however, it is found to be of a waxy nature, streaked with gray, yellow and black and emitting a peculiar aromatic odor. It fuses at 140 to 150 degrees Fahrenheit, and at a higher temperature, gives out a white smoke, which condenses into a crystalline fatty matter.

It is found in all sizes, from one pound up to twenty or thirty, but occasionally pieces weighing one hundred or two hundred pounds are found in whales.

Ambergris has been known from an early period, some pharmacopoeias prescribing it for fevers and nervous complaints. It is sometimes mingled with the incense burned in churches, and is also put in certain kinds of wine to improve the "bouquet."

But the great use of ambergris is in the manufacture of perfumery. Not that its fragrance is either very powerful or pleasing, but it possesses the peculiar property of causing other ingredients to throw out their odors and making them more specific and durable.

In this respect it bears a resemblance to the use of mordants in dyeing, without which the colors would fail to become permanent. Hence all the best perfumes contain ambergris, which is one reason of their costliness, and hence, also, the fact that "home made" cologne, for instance, smells only of alcohol.