It must be admitted that this observation is of little value as a source of satisfaction to the householder; the average man, finding his dwelling damp during the first season, will sell at a sacrifice and thereafter be an enemy of concrete.

No standard building material in use at the present day is absolutely waterproof. Brick and stone absorb varying percentages of water, and a dry interior is obtained only by furring or some other method of producing an air space between the outer section of the wall and the inner finish.—The Cement Age.

Santos-Dumont's Experiments in His Aeroplane "14 Bis."

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

After the first trials of his new aeroplane, Santos-Dumont succeeded in making a flight above the ground which, although of but a short distance, speaks well for the future performance of the apparatus. The flight took place on the 13th of September, in the presence of the Aero Club Commission, with the official timekeepers, for it was intended to compete for the Ernest Archdeacon Cup or the lesser prizes. Starting at 7:50 A. M., the aeronaut threw on the motor, but did not succeed in getting more than 900 revolutions per minute out of it instead of the expected 1,300. The aeroplane traveled at a good speed over the Polo grounds upon its wheels, but without rising entirely. Then the aeroplane was turned about so as to head in the other direction and started on a second run. Before the event the ground had been staked out at 30-foot distances, with a man behind each stake. It was important to measure the space, for a flight of 80 feet would have won the Archdeacon Cup, while a 300-foot flight would have earned a prize of $300. At 8:40 the motor was again started and the propeller turned at more than 1,000 revolutions, which was a good figure, if not at the best speed. The aeroplane rolled over the ground at a speed of 25 miles an hour or thereabouts. When at the proper point Santos-Dumont, thinking that he had a good enough start, turned up the front rudder so as to take the flight in the air.

The two front wheels left the ground, then the rear wheel rose, according to some, three feet, and according to others six feet. This lasted for a second or more, and during this time the aeroplane covered a distance of 15 or 20 feet. For some reason which it is hard to discover, the machine came to the ground again, and in spite of the rubber springs, the shock was enough to bring the rear propeller against the ground. One blade flew off, and the back end of the shaft was fouled; also the bamboo frame was broken at the rear end, and the radiator somewhat damaged. Santos-Dumont was not disheartened by the mishap. He had succeeded in flying a short distance, at least. He hoped to make a longer flight, but perhaps went up too soon by a sudden movement of the rudder. Such a movement is of course difficult to carry out without some practice. Moreover, his propeller did not speed up enough. After making the needed repairs, which will take two weeks at least, he expects to resume his experiments. The aeroplane proper was not damaged in the flight.

On the whole, the result is promising. M. Ernest Archdeacon, president of the Aero Club Commission, made inquiry into the previous aeroplane records and found that none of the previous machines had ever left the ground entirely, so that to Santos-Dumont belongs the honor of having made the first flight in France. The official report states that the apparatus left the ground entirely and sailed at a height estimated diversely at two to three feet, over a distance of 15 to 20 feet, with a speed of 18 to 20 miles an hour in the air.

The Alleged Influence of the Seasons Upon Earthquakes.

The majority of seismologists admit a periodic relation of the shocks of earthquakes with the vicissitudes of the seasons. The maximum frequency is held to occur in the cold season; the minimum, in the warm season. According to a memorandum of Mons. de Montessus de Ballore presented to the Académie des Sciences by Mons. de Lapparent, this theory is without foundation. Mons. de Ballore compared in all 75,737 tremors recorded in 81 catalogues, and corresponding actually with about 60,000 different quakes. The maxima of frequency were distributed in the following manner:

	Maximum of Apparent Seismic Frequency Falling.	
	From October to March, Per cent.	From April to September, Per cent
North latitude to 45 deg	90	10
South latitude to 45 deg..........	47	49*

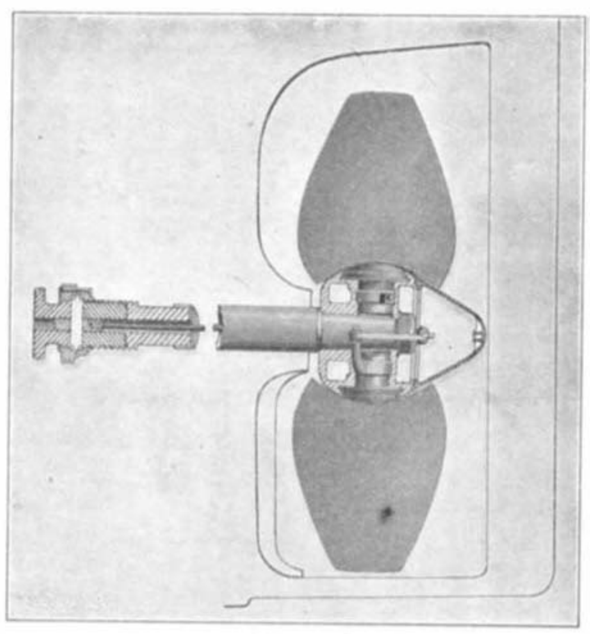
* Four per cent neither maximum nor minimum.

Thus the northern regions (north latitude to 45 deg.) show an enormous preponderance of cases in which the apparent frequency of earthquakes falls during the cold season; the southern regions appear indifferent to this point of view. Mons. de Ballore explains the matter in a very simple way. The number of weak shocks is in an enormous proportion more considerable than that of the shocks somewhat violent, and man perceives these light shocks much better when he is under the shelter of a habitation and quiet, than when he is about and in a state of activity. Now, in the northern regions it is during the cold season (from October to March) that we spend the most unoccupied time and are most under shelter; in the southern regions, the conditions remain perceptibly the same the whole year. Thus would be explained this apparent inequality in the frequency of earthquakes, which according to Mons. de Ballore occur equally at all seasons.—L'Illustration.

THE "R. C. RICKMERS"—THE LARGEST SAILING SHIP AFLOAT.

To Germany belongs the credit of possessing not merely the fastest steamships afloat, but also the largest sailing vessels. The credit for the latter distinction is due largely to the Rickmers Rice Mill, Freight, and Shipbuilding Company, at Bremerhaven-Geestemünde, who during the past few years have built several unusually large sailing vessels, chiefly for the handling of their enormous rice trade. The latest and largest of these ships is the "R. C. Rickmers," which recently arrived at New York on her maiden outward trip to Saigon and Bangkok by way of Cape Horn.

The "Rickmers" differs from her predecessors in the sailing fleet of this company, not merely in size, but in the fact that a decided innovation is being tried by providing her with an auxiliary steam engine, the object of which is to assist the ship across the belt of calms, and also in her movements in harbor when coming to an anchorage, warping alongside a dock, or threading her way through entrance channels and other narrow waterways.



FEATHERING PROPELLER OF THE "R. C. RICKMERS," WITH THE BLADES THROWN PARALLEL WITH THE KEEL FOR SAILING.

The spirited illustration of this great ship, which we present on the front page of this issue, gives an excellent impression of her great length, graceful sheer, lofty bow, and towering spread of canvas. She is shown with practically everything set, and bowling along at 13 to 14 knots on her favorite point of sailing, which is with the wind over the quarter. On deck the "Rickmers" measures 441 feet in length; her extreme beam is 53 feet 8 inches; her draft is 26 feet 9 inches when fully loaded, and her molded depth is 32 feet. Her gross tonnage is 5,548 tons, and on her maximum draft she displaces 11,360 tons. She carries, of course, a huge spread of canvas, the vertical height from the deck to the truck of the mainmast being 177 feet, and the length of the main yard 100 feet. There are five masts, known respectively as the fore, main, middle, mizzen, and spanker. All of the masts are of steel, except that at the extreme top of each there is a 6-foot wooden stump. The total spread of canvas is 50,000 square feet, and as the captain does not hesitate to hang onto every rag of this, long after smaller craft are shortening sail, it can readily be understood that the dimensions of the masts, and the number and size of the steel rope of the wire rigging, are unusual. The mainmast, which is built of half-inch steel plates, measures three feet in external diameter. To stay and hold up to its work the towering spread of canvas on this mast alone calls for no less than thirty shrouds and backstays, fifteen on each side. First there are six shrouds of special 5½-inch steel wire; then come six backstays of the same dimensions, two backstays of 4½-inch wire, and one of 4-inch; and so great is the holding strength of these fifteen ropes, that in the strongest breeze there is very little perceptible slackening of the lee shrouds or backstays. A rather surprising feature in this [illegible] that, in spite of her great size, all the sails are [illegible] by hand by means of special windlasses. The ship's complement consists of fifty-nine hands, two officers and two captains, the ship carrying two captains on the maiden trip only.

The auxiliary equipment consists of a triple-expansion engine of 750 indicated horse-power, steam for which is provided by two boilers; and in the side and between-deck bunkers a fuel supply of 650 tons can be carried. It was found that, in moderate weather, when the ship is in ballast, the engines can drive her at a speed of 8 knots per hour; when she is loaded the speed under steam is from 6 to 7 knots. Because of the great length and easy lines of the "Rickmers" and her large spread of canvas, she is capable, under favorable conditions, of sailing faster than any ship afloat, and probably faster than any ship that was ever built. On the trip to New York, for a period of eight hours, with the wind free, she averaged 15¾ knots per hour, and Capt. A. Walsen informed our representative that judging from this performance and the ability of the ship to carry her canvas in heavy weather, she would probably be able to make 17 knots an hour when going free in half a gale of wind. She is fitted with the well-known Bevis type of patent feathering propeller which, when sail power is to be used, can be so adjusted by means of a central shaft inclosed within the stern shaft, that the propeller blades will lie in the vertical plane of the keel.

The hull of the "Rickmers" is constructed with a cellular water-tight double bottom which, together with the four water-tight divisions, constituting the "deep tank" in the middle of the vessel, can be filled with water ballast to the amount of about 2,700 tons, which is sufficient to give the vessel the necessary sailing stability when she is in ballast. The actual weight of the ship itself is 3,350 tons, and she has a maximum carrying capacity of about 8,000 tons.

THE BIRKELAND-EYDE PROCESS AND THE ARTIFICIAL PRODUCTION OF NITRATES FROM THE ATMOSPHERE.

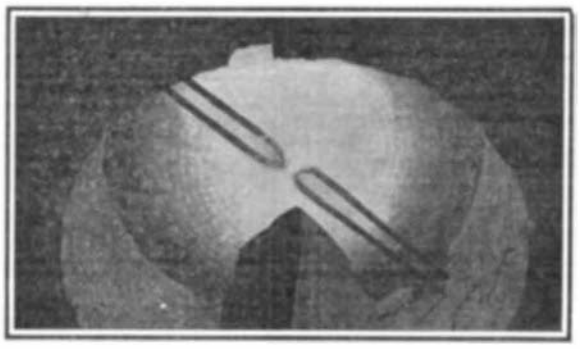
BY M. ALOER.

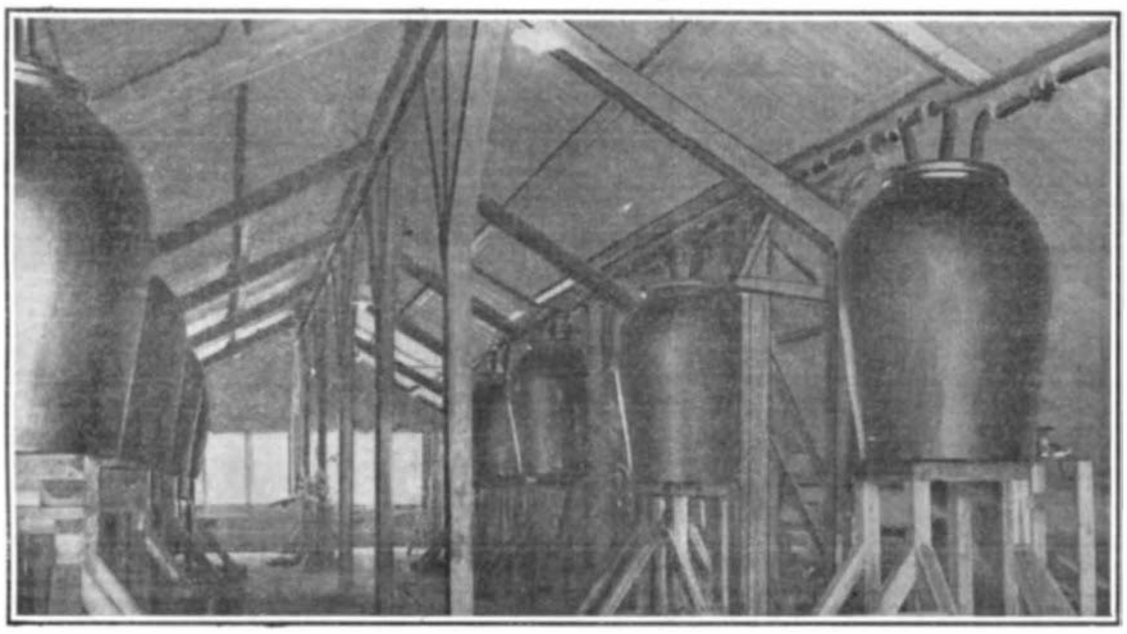
For years Prof. Birkeland, of the Christiania University, and S. Eyde, a civil engineer, have been experimenting with a process of removing nitrogen from the atmosphere by electrical processes for the ultimate purpose of employing it as a fertilizer, in the form of calcium nitrate. The Birkeland-Eyde plant is located at the waterfall Svaelgfos, Notodden, in the district of Telemarken, Norway, where 30,000 horse-power will soon be utilized, and large amounts of nitrate of calcium for direct use will be produced. In all processes for the reduction of atmospheric nitrogen the air is exposed to the high temperature of the electric arc, and cooled as rapidly as possible after the combination of a portion of the atmospheric oxygen and nitrogen. Without rapid cooling the compound decomposes. Furthermore, only very small arcs can be employed, for the larger the arc the smaller will be the amount of air exposed to the flame. In the Birkeland-Eyde process a short arc is formed at the terminals of the closely adjacent electrodes, establishing an easily movable and ductile current conductor in a strong and extensive magnetic field, i. e., from 4,000 to 5,000 lines of force per square centimeter in the center. The arc then moves in a direction perpendicular to the lines of force, at first with an enormous velocity which subsequently diminishes; and the extremities of the arc retire from the terminals of the electrodes. As the length of the arc increases its electrical resistance also increases, so that the tension is increased until it becomes sufficient to create a new arc at the points of the electrodes. The resistance of the short arc is small; hence the tension of the electrodes drops suddenly, with the result that the outer long arc is extinguished. In alternating current such as that used by Birkeland and Eyde all the arcs with a positive direction run one way, while all the arcs with a negative direction run the opposite way, assuming that magnetization is effected by direct currents. In this manner a complete luminous disk is presented to the eye.

The arcs are contained in flat iron drums or furnaces lined with asbestos and mica. The electrodes are formed of copper tubes, through which cooling water flows, and are placed equatorially between the poles of a powerful electromagnet. The temperature to which the current of air passing through the drum is exposed is approximately 3,000 deg. C. (5,432 deg. F.); and it is calculated that one-fifth of the air acquires this temperature.

The nitrogen and oxygen combine to form nitric oxide; if this gas were allowed to cool slowly to atmospheric temperature, it would again be resolved into its constituents, but the arc closes and the gas is suddenly cooled, so that much of it escapes decomposition, and is swept along with the current into absorbers. It issues from the drum at a temperature of 600 deg. or 700 deg. C. (1,112 deg. to 1,292 deg. F.) and it passes through the tubes of tubular boilers and raises steam, which is utilized in a manner afterward to be described.

The nitric oxide, NO, combines with oxygen to form nitric peroxide, NO_2, on issuing from the boiler tubes; and it then passes through a succession of towers filled with broken quartz, over which water trickles. Nitric acid is thus formed. But not all the gas is absorbed; the unattacked air which passes along with it dilutes it to such an extent that at least half escapes absorption. Therefore, after passing the water towers, it enters a tower charged with milk of lime, and there it is nearly all absorbed, with the exception of about 5 per cent. The lime is converted into a mixture of calcium nitrite and nitrate. Nitrite of calcium is useless as a fertilizer; it is the nitrate alone which is valuable. The nitrite must therefore be converted into nitrate. This is done by adding to it a portion of the nitric acid, condensed in the towers, and distilling. The nitrite is decomposed; nitrous fumes, consisting of a mixture of NO and NO_2, pass over, and the lime is left in the liquor as a nitrate.

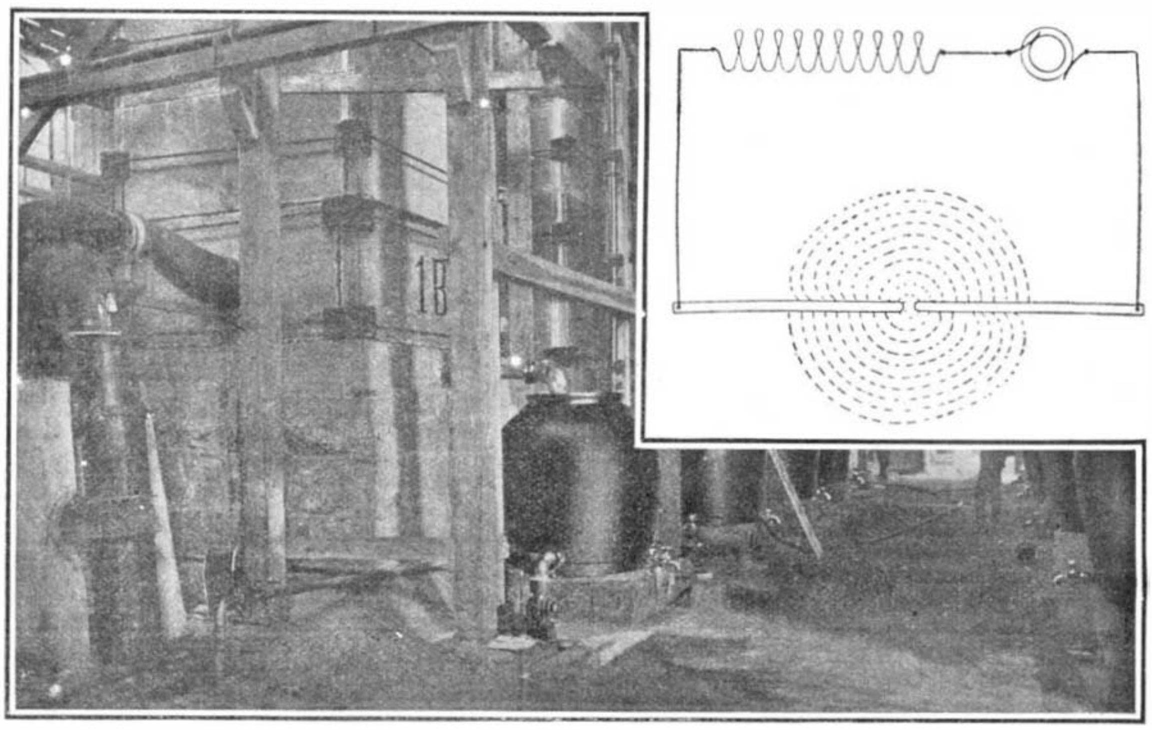

The Electric Arc Flame and Water-Cooled Electrodes.

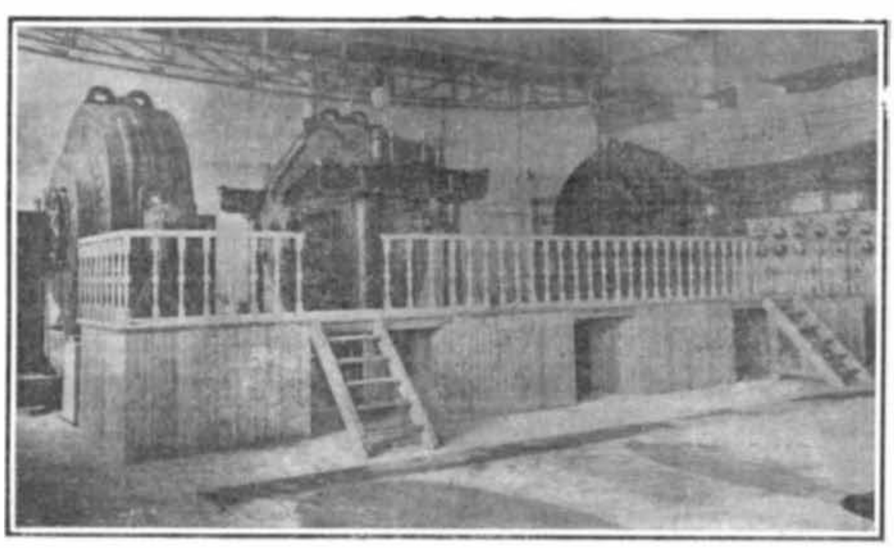

Acid-Proof Receptacles Into Which Vapors Pass.

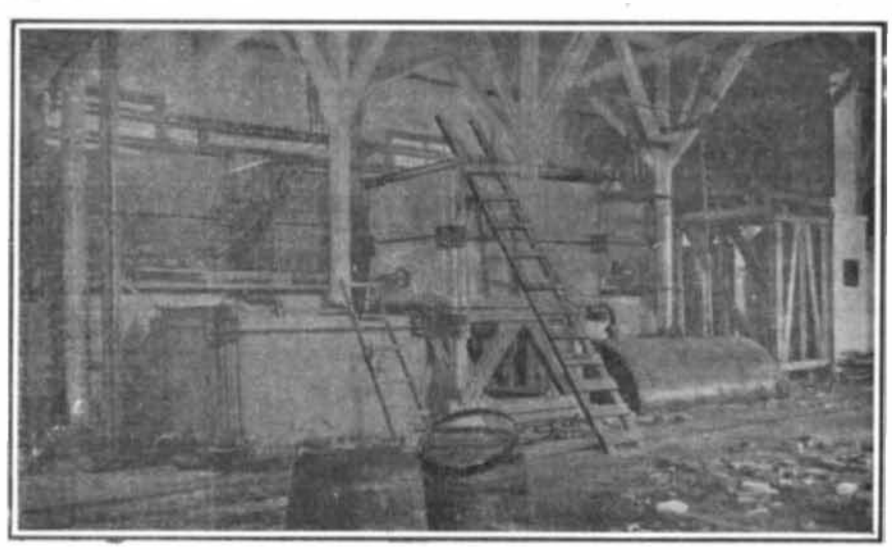
It is this nitrate solution which is evaporated by help of the steam raised in the boilers heated by the escaping gas. The nitrate of calcium may be brought to market in one of these forms: first, in a fused state, in which it contains 13.5 per cent of nitrogen; secondly, in crystals; and thirdly, as a basic salt, which forms a dry powder, not becoming moist on exposure to air. This valuable suggestion to use the basic nitrate and thus to produce a dry and non-deliquescent marketable article is due to Dr. Rudolph Messell. The extra lime which is introduced adds little to the cost and is itself of agricultural value.

The nitrous fumes are not lost. They may either be absorbed in caustic soda, giving nitrite of sodium, a salt much used by manufacturers of organic dyes, or they may be mixed with the stream of gases which have passed through the boiler tubes, and pass to the water towers, whereupon a portion will yield nitric acid and the rest will again be absorbed by lime.

It is also possible to electrolyze the sodium nitrite, and to form ammonia and caustic soda; the ammonia can be distilled off and neutralized with nitric acid, giving the valuable product nitrate of ammonium, of use for explosives, the caustic soda being available for again absorbing the nitrous fumes. During electrolysis, oxygen is evolved, which may be introduced with air into the furnace, for air richer in oxygen forms more nitric oxide in the flame.


Absorption System of Stone Towers for Producing Nitric Acid.


The Arcs Are Formed in Flat Iron Drums.


The Oxidizing Chambers.

THE BIRKELAND-EYDE PROCESS AND THE ARTIFICIAL PRODUCTION OF NITRATES FROM THE ATMOSPHERE.

Automobile Steam Plowing.

In Cairo some very interesting tests with an automobile steam plow have been made at the instance of the multi-millionaire, his Excellency Boghos Pacha Nubar, and the Khedival Society of Agriculture. The results seem to promise favorably as regards the conditions prevailing in the Land of the Pyramids. The machine consists of a steam road locomotive of 40 horse-power, used as a traction motor for a plow working a breadth of 330 centimeters or 1,056 feet. The work done was about twice that done in the same time by the ordinary steam plow with rope traction, and about three times that which could have been done by animal traction. The experiments were conducted in a clover field that had not been plowed for many months and was perfectly dry and quite hard. The field was 300 meters or 924 feet long. The plow worked in an hour's time 6,729 meters of land, to a depth of 0.20 meter, or say eight inches, and the coal-briquette consumption was for 0.4 hectare, or 9.88 acres, only 100 kilogrammes, or 220 pounds. The fact that this type of plow can work in hard, dry ground makes it particularly adaptable to Egyptian cotton cultivation. The commission charged with the test endeavored to ascertain if the plow would mix artificial fertilizers well in with the soil, and found it in this particular quite satisfactory. The necessary labor required consists of one engine-runner, one stoker, and two men to look after the coal and water supply—this latter item seeming to Americans rather superfluous, or at any rate excessive. The advantages claimed for the automobile type over the traction plow are that it makes a better turned furrow (just why is hardly plain at first sight to those not on the spot), works faster, is more quickly turned at the end of the furrow (in this case thirty seconds is the time claimed), and can be kept supplied with water without stopping work, which, however, ought to be the case with any steam engine.

Generating Electricity at the Pit's Mouth.

Of recent years a good deal has been said about generating electricity at the pit's mouth, and transmitting it to various industrial centers. But it would be considerably cheaper to manufacture producer gas at the pit's mouth and transmit it through pipes to the industrial centers, there to use it for driving gas engines for generating electricity and also for heating purposes and furnace work. The questions of the distribution and transmission of power must not be confused. For the former it is agreed that there is no agent to compare with electricity. For the latter purpose it is suggested that it is more economical to employ producer-gas and piping than electricity and cables.