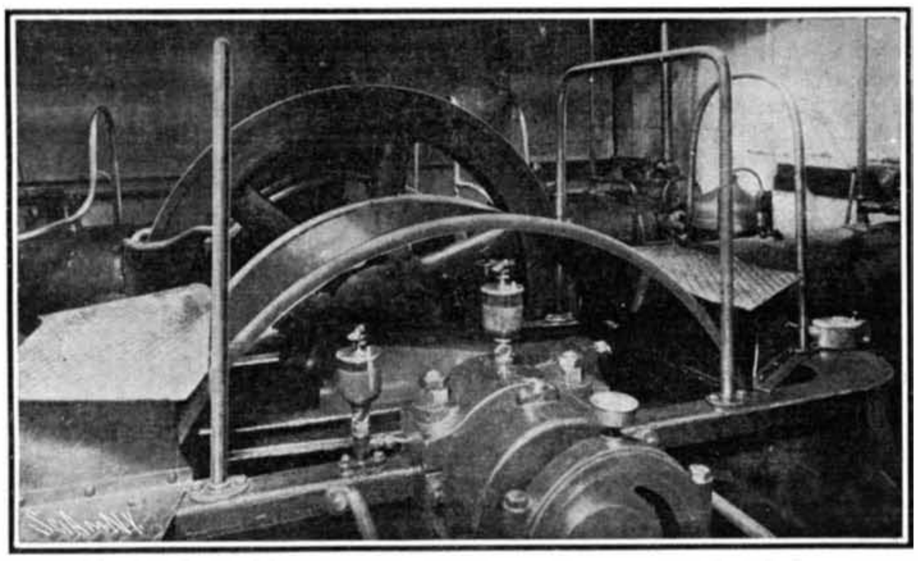
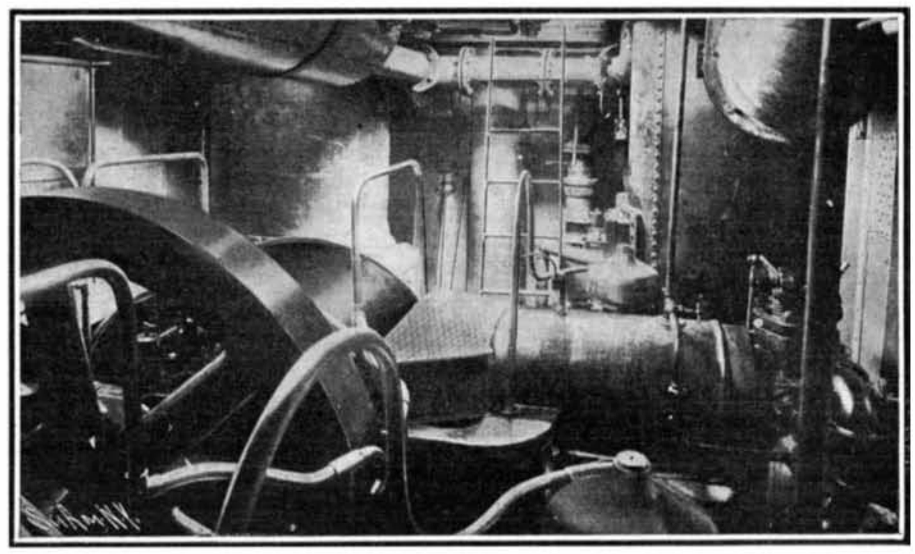
## 100-HORSE-POWER SUCTION-GAS-PROPELLED BOAT ON THE RIVER RHINE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The utilization of the suction gas engine for certain classes of marine work, such as the propulsion of barges, as designed by the well-known Otto Gas Engine Company, of Deutz, is being extensively developed in Germany for freight-carrying traffic between the inland industrial centers and cities and the principal seaports on the coast. This movement is due to the greater economy that is proved to be derivative from the employment of this system of propulsion, since it enables the craft to be operated much more cheaply than is possible with steam or any other type of traction, while the work can be carried out much more expeditiously and efficiently than by towage either with animal, tugboat, or other power.



Four-Cylinder, 100-Horse-Power Producer-Gas Engine of the "Lotte." The Engine is Started by a 6-Horse-Power Motor.



Engine Room of the Producer-Gas Boat "Lotte." Producer on the Left. Scrubber in the Right-Hand Corner.

The Otto Gas Engine Company have up to the present fitted their suction gas system upon eleven vessels, the power of the various engines ranging from 35 horse-power to 90 horse-power. In these craft the design of the engine has followed the well-known horizontal arrangement, the number of cylinders in the case of the 35 horse-power engine being two, while for others developing the greater powers four cylinders are employed, in order to obtain a more perfect balancing of the engine. In the case of the 90-horse-power boat the engine has a running capacity up to a maximum of 325 revolutions per minute.

Recently, however, the company have carried out another installation upon similar lines, which possesses especial interest, inasmuch as it is one of the largest installations of this type of plant for river traffic that has yet been designed. The craft in question, known as the "Lotte," is a flat-bottomed barge such as is generally used for this class of work, measuring 139 feet 6 inches in length with a beam of 15 feet, and having a draft of 6 feet 6 inches with a load of 240 tons. The engine, which is of the four-cylinder horizontal type, develops a maximum of 100 horse-power. It was originally designed for service upon the River Elbe, but when it was completed by the engine builders it was retained by them for their own river traffic between Cologne, Antwerp, and Rotterdam, a total distance of about 190 miles.

The engine, together with its necessary equipment comprising the producer, scrubber, etc., occupies but little space, being very compact and with the integral parts placed conveniently together, as the accompanying illustrations show. The gas producer is placed in front of the engine room and separated therefrom by a bulkhead with sliding doors, which may be closed during the time the grate of the gas producer is being cleaned and the ashes and clinker removed. In the opposite corner is placed the scrubber, while over the engine is carried the gas equalizing box. The engine is placed athwart the vessel, so that the crankshaft extends centrally, and in the same longitudinal plane as the propeller shaft, to which it is connected. The flywheel is placed between the sets of twin cylinders, is about five feet in diameter, and of heavy proportions.

For facilitating starting there is a small single-cylinder motor developing 6 horse-power, and driven by benzine fuel, which sets the main engine in motion by means of a frictional connection with the flywheel, this coupling being continued until the ignition in the cylinders of the larger engine commences, and the latter has attained sufficient momentum to run without further assistance, when the small motor is thrown out of gear. This benzine engine also drives through belting and shafting a small fan-blower that is brought to bear upon the fuel in the producer, after the engine has been standing stationary for some time, thereby enlivening the combustion of the fuel within the gas producer.

The power exerted by the engine varies from 80 to 100 horse-power, and at the latter maximum power the engines are capable of driving the boat with a full load of 250 tons, at a speed of 3½ miles per hour against the current in the river, which at some places is somewhat swift and powerful. The total space occupied by the engines and necessary generating plant is approximately 14 feet in width by 20 feet in length.

Propulsion is carried out by a single screw 4 feet 3 inches in diameter, fitted with four blades which are made reversible in direction by a rack-and-pinion motion. The reversing gear constitutes an interesting feature of the vessel. The rod which carries out the reversing motion ends in a series of toothed racks which gear with corresponding pinions on the axes of the reversible propeller blades. There is a combination comprising a friction coupling, differential gear wheels, toothed clutches, and helical gearing, through which the power requisite for reversing is taken from the main engine shaft, and the action of this combination causes the reversing rod to be moved backward or forward as the case may be. To operate the mechanism the clutch is thrown either into the forward or back gear by the manipulation of the frictional coupling with the main engine shaft. It is also possible to vary the pitch of the propeller blades in accordance with the action of the engine, there being a divided scale, and by varying the pitch in consonance with this it can be gradually increased until the maximum load is attained.

This vessel has proved highly economical in operation. The distance between Cologne and Rotterdam is 187½ miles, and the time occupied on the round trip including all stoppages, with an average load of 200 tons, occupies fourteen days, giving an average daily run of 27 1-7 miles under all conditions, thereby enabling twenty-six round journeys per year to be accomplished. The cost of the vessel is approximately $11,250 and the annual expenses of operation, maintenance, etc., work out as follows:

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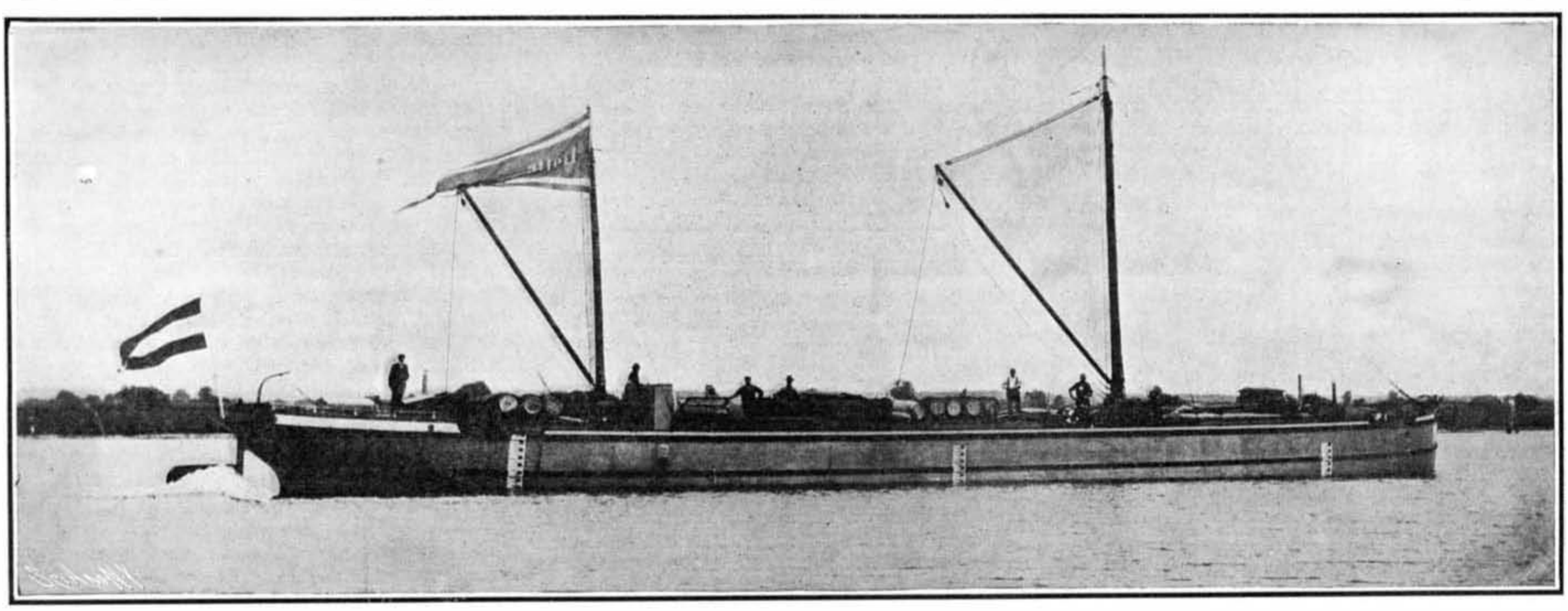
|---|---|
| Depreciation on hull, 5 per cent on $5,000 | $250.00 |
| Depreciation on engines, 10 per cent on $6,250 | 625.00 |
| Interest on capital, 5 per cent on $11,250 | 562.50 |
| Insurance | 11.25 |
| Navigation dues, 26 round trips | 975.00 |
| Fuel—anthracite at $5 per ton—burned at the rate of 1.32 pounds per horse-power hour for 75 hours per round trip, 50 hours upstream and 25 hours downstream — 117 tons | 585.00 |
| Lubricating oil, etc. | 243.75 |
| Wages | 1,750.00 |
| Total annual outlay | $5,002.50 |

During the year, 5,200 tons were carried, representing 1,950,000 ton miles, which corresponds to a cost of about 0.25 cent per ton. Had the material been transported from Cologne to Rotterdam by the ordinary steamboats, the tariff for transport would have been about 50 per cent higher, while the lowest rate by the railroad would have been five times as much. On the Saarbrücken-Mühlhausen canal there is a barge of 240



THE SUCTION-GAS-PRODUCER BOAT "LOTTE."

tons fitted with a similar engine, and in this case the round trip of 170 miles occupies thirty days, including nine days' detention, and nine days with light load. Under these disadvantageous conditions the cost of transport by the suction-gas propelled craft is 33 per cent lower than that of horse traction, while the boat during the year makes eleven round trips as compared with seven complete journeys which were possible by animal traction before the introduction of the present system.

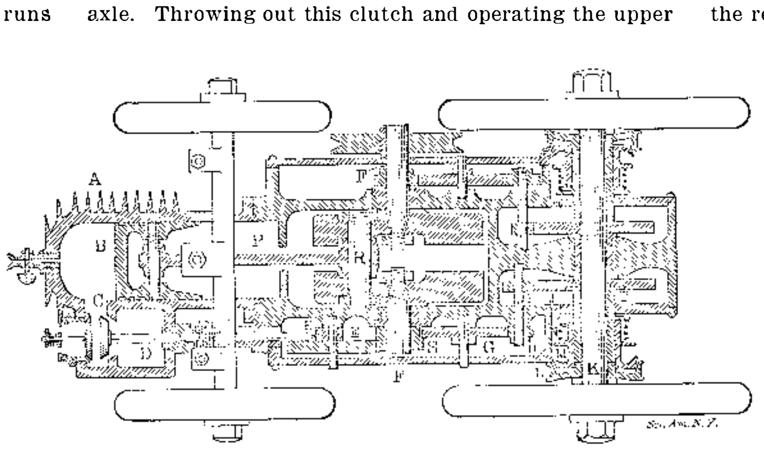
## MOTOR ROLLER SKATES.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The new motor skate which has been lately brought out at Paris by M. Constantini, a well-known inventor of carbureters and other devices for automobiles, is attracting considerable attention owing to its novelty, seeing that this is the first time that a gasoline motor has been applied to a roller skate. A short time ago we gave a description of this apparatus, which was exposed for the first time at the Paris Automobile Show. Since the above article appeared we have been able to secure the present photographs, which were kindly supplied by the inventor. These show the skates as they are applied to the person. In view of the fact that each skate contains a gasoline motor, carbureter, battery, and spark coil, it will be seen that the whole has been reduced to a comparatively small size. The use of the rubber-tired wheels is found to give a very smooth-running movement. On the back of each skate will be observed the small sheet-iron box which contains the battery and the spark coil. From the box a pair of wires protected by rubber tubing passes up to the leather belt which the person wears, and upon the belt is placed the switch by which he is able to make or break the ignition circuit when he wishes to start or stop the motor or to regulate its speed. On the back part of the belt is fixed a small gasoline tank in the form of a flat and slightly curved sheet-iron box. From this reservoir a small rubber pipe specially treated to withstand the deteriorating action of gasoline runs down to the skate and connects with each of the carbureters. A second controlling device fastened to the belt enables the person to adjust the gasoline feed from the tank to each of the motors. The gasoline reservoir is made to hold from one-quarter to half a gallon of fuel. Owing to its small size and flat form it occupies but little room and, as will be observed, is covered by the coat, leaving nothing visible but the tubes and wire running to the skates. Each motor weighs 4 kilogrammes (8.8 pounds) and consumes a liter of gasoline per 60 kilometers (¼ gallon every 35 miles). The weight of the skate complete is but 6 kilogrammes (13.2 pounds), and speeds of from 3 to 25 miles an hour are obtainable with it. To start, the operator turns on the gasoline, relieves the compression by means of a special valve-raising lever, and then skates along the road. As soon as he has gotten under way, he switches on the ignition current, and the motors begin to operate. If the novice does not take care to lean forward at this moment, the sudden acceleration may upset him. To stop, it is only necessary to break the ignition circuit or to raise one's self upon the front wheels. By doing the latter, the driving wheels are raised off the ground and the motors race, running free. If one motor runs faster or better than the other, the operator can correct this by moving that foot back of the other, or by bearing more weight upon the faster-running skate. M. Constantini has given the new skate a very thorough trial and has been exercising with it in the parks near the city. He finds that a person can travel either at slow speed or at quite a rapid rate, and that he soon becomes accustomed to using the device, and to controlling the speed of the motors easily.

At present the inventor is engaged in constructing two different types of motor skate. The first of these is the one we have already described in detail in a preceding number, and which is shown in the present illustrations, it having been but slightly improved in the details since the last account. Since then the inventor has designed a new form of motor skate, which he has already constructed at his factory. In the second form the exterior of the skate remains about the same, but otherwise it differs considerably from the one just mentioned. The main difference lies in the fact that only one of the skates is fitted with a gasoline motor, and the latter is made to drive the second skate by means of a rod which passes across and connects the two. The rod has a universal joint on each end at a point near the skate, and is attached at one end to the motor body and at the other to the frame of the second skate. In this way the rod keeps the skates spread at the right distance and makes the whole system quite steady, especially as the feet cannot spread accidentally too far apart, such as often happens with roller skates. In practice it is thought that there will be no disadvantage in having the two skates thus connected together. The motor has been made larger in this case and has power enough to operate both skates. This form is intended to be used by sportsmen, for races, and in all cases where a high speed is wanted, while the first form is adapted for moderate speeds.

In the second form of skate, of which we give a sectional view, the available space between the four wheels is almost entirely taken up by the large motor and its carbureter, while the space under the second skate is utilized to stow the gasoline tank, which is of considerable size, and also the battery and spark-coil, thus dispensing with the double battery and coil which the first system uses. The gasoline tank has a capacity of about a gallon, and this is found upon trial to be enough for a run of 50 or 60 miles. A rubber tube passes across along the rod to take the gasoline over to the motor on the other skate. A novel feature is the use of two different speeds on the wheels, and this is obtained by the arrangement which is shown in the section. The motor is placed in a nearly horizontal position. The air-cooled cylinder is seen at *A*, the piston at *B*, the connecting rod at *P*, and the crank at *R*. At *C* are the valves, which are operated by a rod from the cam, *E*, the latter being driven by a gear from the motor shaft. This shaft is in two halves, as indicated by the letters, *FF*. From the upper half a set of gears connects with the rear axle. A similar gear train is driven from the lower half. The two gear trains have different ratios and they can be connected with the rear axle by a friction clutch on either side. Thus, on the lower side we have the pinion, *S*, mounted on the motor shaft, working with the gear, *G*; and then the pinions, *H* and *I*, mounted on a countershaft, and the gear, *J*, on the rear axle. The latter gear is mounted on a collar, *T*, which runs loose on the axle. Keyed to the collar and sliding upon it is the friction cone, *M*, which is pressed down by the spring, *N*. This cone works in a second cone, *L*, which is keyed fast to the axle. By operating a lever we allow the spring to throw in the lower clutch and thus obtain a given speed on the rear axle. Throwing out this clutch and operating the upper one gives a second speed from the other train of gears, which has a different speed reduction. M. Constantini expects to organize a special event in order to bring his system to the attention of the public. Three sportswomen equipped with the skates are to have a race over some of the principal avenues of the city, from the Place de la Concorde to the Maillot Gate, where the paving is either asphalt or wood, and has a smooth surface. Racing events are also to be held in the Velodrome. To show the interest which the new device has already awakened, we may state that the Shah of Persia has ordered three pairs of the motor skates. The inventor has already had several flattering offers for the sale of the English and American patents.



HORIZONTAL CROSS-SECTION OF THE LATEST FORM OF MOTOR ROLLER SKATE.

### Official Meteorological Summary, New York, N. Y., March, 1906.

Atmospheric pressure: Mean, 30.09; highest, 30.90; lowest, 29.45. Temperature: Highest, 55; date, 27th; lowest, 16, date, 24th; mean of warmest day, 50; date, 27th; coldest day, 21; date, 23d; mean of maximum for the month, 40.6; mean of minimum, 29.2; absolute mean, 34.9; normal, 37.6; average daily deficiency compared with mean of 36 years, —2.7. Warmest mean temperature for March, 48, in 1903; coldest mean, 29, in 1872. Absolute maximum and minimum for this month for 36 years, 74, and 3. Precipitation: 5.58; greatest in 24 hours, 2.44; date, 3d and 4th; average for this month for 36 years, 4.09; excess, +1.49; greatest precipitation 7.90, in 1876; least, 1.19, in 1885. Snow: 13.4. Wind: Prevailing direction, northwest; total movement, 12.017 miles; average hourly velocity, 16.2 miles; maximum velocity, 64 miles per hour. Weather: Clear days, 7; partly cloudy, 12; cloudy, 12.

One of the London motor omnibus companies annually writes 25 per cent off the value of its motor vehicles for depreciation. This is more than some advocates of motor traffic deem necessary, but omnibus work is much more severe on the vital parts than that of other forms of motor vehicles.

### The Electric Production of Nitrates from the Atmosphere and Its Significance to Mankind.*

BY PROF. SILVANUS P. THOMPSON, D.SC., F.R.S.

As the demand of the white races for wheat as a food-stuff increases, the acreage devoted to wheat-growing increases, but at a less rapid rate; and, being limited by climatic conditions, it will, in a few years, perhaps less than thirty, be entirely taken up. Then, as Sir Wm. Crookes pointed out in his presidential address in 1898, there will be a wheat famine, unless the world's yield per acre—at present about 12.7 bushels per acre on the average—can be raised by the use of fertilizers. Of such fertilizers the chief is nitrate of soda, exported from the niter beds in Chili. The demand for this has risen from 1,000,000 tons in 1892 to 1,543,120 tons in 1905; and the supply will, at the present rate, be exhausted in less than fifty years. Then the only chance of averting starvation lies, as Crookes pointed out, through the laboratory.

In 1781, Cavendish had observed that nitrogen, which exists in illimitable quantities in the air, can be caused to enter into combination with oxygen, and later he showed that nitrous fumes could be produced by passing electric sparks through air. Although this laboratory experiment had undoubtedly pointed the way, though the chemistry of the arc flame had been investigated in 1880 by Dewar, and though Crookes and Lord Rayleigh had both employed electric discharges to cause nitrogen and oxygen to enter into combination, no commercial process had been found practical for the synthesis of nitrates from the air until recently.

After referring, in passing, to the tentative processes of Bradley and Lovejoy, of Kowalski, of Naville, and to the cyanamide and cyanide processes, attention was directed to the process of Birkeland and Eyde, of Christiania, for the fixation of atmospheric nitrogen, and their synthetic production of nitrates, by use of a special electric furnace. In this furnace an alternating electric arc was produced at between 3,000 and 4,000 volts, but under special conditions which resulted from the researches of Prof. Birkeland; the arc being formed between the poles of a large electro-magnet, which forced it to take the form of a roaring disk of flame. Such a disk of flame was shown in the lecture theater by a model apparatus sent from Christiania.

In the furnaces, as used in Norway, the disk of flame was 4 feet or 5 feet in diameter, and was inclosed in a metal envelope lined with firebrick. Through this furnace air was blown and emerged charged with nitric oxide fumes. These fumes were collected, allowed time further to oxidize, then absorbed in water towers or in quicklime, nitric acid and nitrate of lime being the products. The research station near Arendel was described, also the factory at Notodden, in the Hitterdal, where electric power to the extent of 1,500 kilowatts was already taken from the Tinnfoss waterfall for the production of nitrate of lime. This product in several forms, including a basic nitrate, was known as Norwegian saltpeter. Experiment had shown that it was equally good as a fertilizer with Chili saltpeter, and the lime in it was of special advantage for certain soils. The yield of product in these furnaces was most satisfactory, and the factory at Notodden, which had been in commercial operation since the spring of 1905, was about to be enlarged; the neighboring waterfall of Svaelgfos, being now in course of utilization, would furnish 23,000 horse-power. The Norwegian company had further projects in hand for the utilization of three other waterfalls including the Rjukanfos, the most considerable fall in Telemarken, which would yield over 200,000 horse-power. According to the statement of Prof. Otto Witt, the yield of the Birkeland-Eyde furnaces was over 500 kilogrammes of nitric acid per year for every kilowatt of power. The conditions in Norway were exceptionally good for the furnishing of power at exceedingly low rates. Hence the new product could compete with Chili saltpeter on the market, and would become every year more valuable as the demand for nitrates increased and the natural supplies became exhausted.

### Aluminium Breastplates.

The Italian expert, Scandroglio of Leglano, has prepared three kinds of breastplates. The first is composed of six plates of pure aluminium 0.5 millimeter thick, rolled, placed one on another, and wrapped in sized cotton canvas; it resists lead projectiles of 10.35 millimeters in caliber. The second is formed of two plates of aluminium with 4 per cent of copper, rolled, 2 millimeters in thickness, and covered with sized canvas. It stops the projectile of the Italian revolver of the 1889 model. The third breastplate contains three plates of the same metal, 5 millimeters thick, and stops the ball of the Italian musket of the 1891 model. These breastplates are claimed to be less thick and heavy than those previously used with the same results.

* Abstract from a discourse delivered at the Royal Institution, London.