Analyzing the Air.

We learn from the *Sanitary World*, London, that an analysis is about to be made of the air in the schools, public halls, theaters, and some of the churches of Edinburgh. In several cities, both on the Continent and in Britain, the custodians of the public health have had the air of places of public resort analyzed ; and now through the efforts of Dr. Russell, the convener of the Public Health Committee, the same is being done for Edinburgh. The first examination was made in the rooms of the council chamber recently. The apparatus used in the process is contained in a large box. Three different sets of apparatus are employed—one for testing for carbonic acid gas, a second for germs, and the third for organic matter. In connection with the analysis for carbonic acid, the air is pumped by a bellows into bottles with a capacity of a gallon and a half, the air from different heights being obtained by means of an adjustable India rubber tube. In the analytical process a solution of baryta is used. This poured into the bottles containing the air absorbs the carbonic acid, and forms a white powder at the bottom of the vessel. A given quantity of baryta being capable of absorbing a given quantity of carbonic acid gas, the measurement of the baryta remaining in solution in the bottle gives, on a simple calculation, the quantity of carbonic acid gas which was in the amount of air sampled. For the collection of those mysterious germs which are never entirely absent from the atmosphere, and whose functions have not yet been satisfactorily determined, a glass tube about 2 inches in diameter and 2½ feet in length is used. This, coated internally with a transparent gelatine, in which the germs can live and thrive, is brought to the place the air of which is to be tested, germ free. A reversing aspirator is affixed to it, and a measured quantity of air is then drawn through the tube, on the sides of which the germs deposit themselves. At first these are not distinguishable by the naked eye ; but in the course of three or four days they have formed colonies and multiplied so exceedingly that a glass is no longer needed to pick them out. Ultimately they are subjected to examination under high microscopic power, so as to determine, if possible, their genera, and whether or not they are disease-producing germs. They are mostly vegetable, and belong to the very lowest order of things endowed with life. For determining the amount of organic matter, the apparatus used consists of a set of six bottles filled with the purest distilled water, and connected together by means of tubes. The aspirator is put on to one end, and the air is then sucked into the bottles drop by drop, and thoroughly washed in its passage through them. No perceptible discoloration of the water ensues by this washing of the air, but the water acquires a stuffy, disagreeable smell, the same as is experienced in a badly ventilated chamber. The water thus impregnated with organic matter is then emptied into a vessel for analysis. These investigations are being made by Dr. Hunter Stewart, who directs under Sir Douglas Maclagan the Public Health Laboratory in the University, and by Mr. Cosmo Burton, B.Sc., well known as an analytical chemist.

The New Steel Gun.

The army ordnance officials are quite jubilant over the results obtained last week at Sandy Hook with the new 8-inch steel gun, which was recently hooped to the muzzle after having been fired successfully 24 rounds. Since the rehooping, the gun has been fired 19 rounds, making 43 rounds in all. The ordnance officers who witnessed the trial report that during the last firings the gun, with a powder charge of 110 lb. and a 289 lb. shot, gave the following results : Initial velocity, 1,878 ft.; pressure, 36,000 lb. per square in.; energy, 7,066 ft. tons. With a 302 lb. shot, the powder charge and density of loading being the same, the results produced were : Velocity, 1,857 feet per second ; pressure, 37,000 lb. per square inch ; and energy, 72·19 foot tons, which is equivalent to an energy of a shot of 289 lb. weight with a velocity of 1,898 feet per second. These results are considered equal to those given by the Krupp 8¼ inch gun, and considerably in advance of anything produced by guns of similar dimensions. Still better results are anticipated with improved powder. The gun went through the last firings without a blemish, the breech mechanism (the De Bange system) working admirably. —*Army and Navy Jour.*

Transparency of Molten Iron.

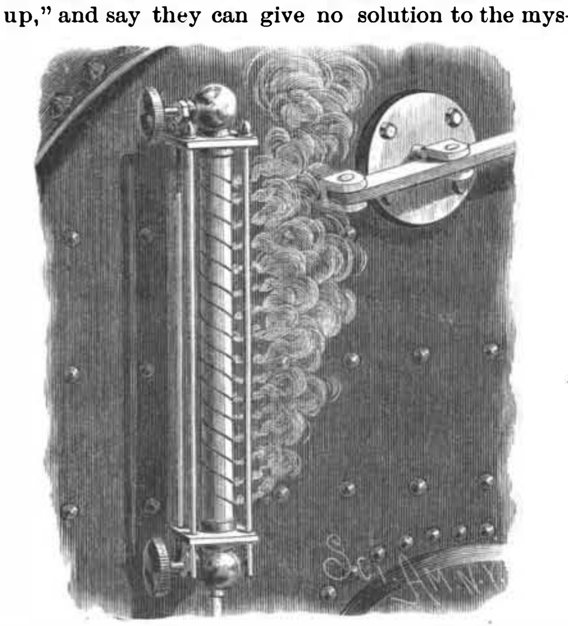
A correspondent of the *Chemical News* says : Some days ago I was present when a casting was made involving the pouring of several tons of molten cast iron. The stream was very regular, and resembled a great waterfall. It was possible to see objects through the molten metal, which appeared to be of a yellowish color, but tolerably transparent. Two gentlemen who were present were also convinced of the transparency of the metal. May I ask, through your columns, the opinion of those who have frequent opportunities of being present during the operation of casting, regarding this seeming transparency?

Correspondence.

CURIOUS ACCIDENT TO A WATER GAUGE OF A LOCOMOTIVE.

To the Editor of the Scientific American :

I inclose you photograph of water gauge glass which was cut while in service, in the spiral form shown, the steam and water escaping through the cut. Engineer H. Bokeloh, of engine 19, C., I., St. L. & C. Railroad, tells the following story : December 15, 1886, I had occasion to take the glass from its sockets while under steam, replacing it upside down. As soon as steam was turned on, opening lower waste cock, a small particle of something passed through, cutting the glass and escaping through the cock with the waste steam. I could not find what it was. When the cock was closed, the water and steam escaped through the whole length of spiral. It is considered a great curiosity here ; many veteran engineers have "given it up," and say they can give no solution to the mystery. The glass is kept, with a photograph of same, in Master Mechanic Patterson's office, Cincinnati, where it is daily inspected by many engineers.



GEORGE B. HAVENS.

Indianapolis, Ind., January 24, 1887.

[It is well known among dealers that many of the Scotch water gauge glasses are under internal strain from deficient annealing. The least scratch will cut them like a diamond. They sometimes split after being cleaned with cotton waste on a wire or small iron rod, the contact of the wire or rod causing fracture. The point of a small file run around on the inside cuts as clean as a diamond. In the case of the spiral cutting written of by our correspondent, and represented in the accompanying engraving, the steam or water, in entering the tube, takes a spiral movement from some peculiarity in the opening in the cock or valve, as is often observed. Any scale or hard substance entering with the steam or water will partake of the whirling motion of the steam or water as it progresses through the tube. If the scale by its gravity acquires a centrifugal force that throws it against the tube and keeps it there, through the whole course of the spiral movement of the steam or water, this may be sufficient to cut the spiral track shown in the engraving, which is a careful copy of a photograph of the glass itself.—ED.]

Exposure as a Preservative of Health.

To the Editor of the Scientific American :

In the army we had for tents rectangular pieces of canvas four feet square, two of which, joined at the edge, and supported upon sticks in the form of a V-roof, formed a shelter for the night. Under these we slept on blankets placed upon the ground, and such perfect, strength-renewing, and invigorating sleep I never experienced before nor since. A mere canopy over us, with the winds blowing across our faces during the night at their own sweet will. I scarcely knew then what it was to have a cold. I have been filled with astonishment at times, when realizing what exposures I endured without the least inconvenience as to health.

I have lain upon blankets upon frozen ground at night, and awakened in the morning to find the blankets wet from the mud beneath me, caused by the ground thawing from the heat I had furnished during the night. I have repeatedly, at the close of a long, tedious march, lasting until late in the evening, lain down by the side of a fence in clothes wet with perspiration, with boots for a pillow, and without covering, and slept refreshingly, to wake in the morning in rain that had been falling I knew not how long. Under such extreme exposures I would sometimes arise with a slight hoarseness—nothing more—which would disappear before noon. My experience was not different from that of others around me, and how any of us passed through these things and lived twenty-four hours thereafter has never ceased to be a mystery to me. A person worn and exhausted from hard labor is peculiarly fitted to become the victim of colds and rheumatism, if exposed to dampness and chilly air, and yet these were the very conditions under which we, at the end of a laborious march, would seek the comfort the ground gave us, too weary to give much thought to the matter of protection. Troublesome chilblains that had afflicted me since childhood entirely disappeared. War life will, I believe, kill one man out of twenty and make robust, healthy men of the other nineteen.

After our discharge, the first night's sleep in a house found us suffering from colds, in some cases truly severe, and I have always believed since my army experience that man, as an animal, has no business in-doors, where health-destroying draughts are creeping along the floors and walls. The recent correspondence in the SCIENTIFIC AMERICAN on this subject has brought vividly to mind my army experience.

E. B. WHITMORE.

Rochester, N. Y., March 24, 1887.

Rotation of a Solid within a Fluid.

To the Editor of the Scientific American :

The account of Rougerie's "Anemogene," which you have republished from *Engineering*, is interesting as a device for illustrating the effect of centrifugal force due to rotation of a solid within a fluid ; but M. Rougerie's idea that the rotation of the earth is an important factor in giving rise to the great currents at its surface is by no means new. The statement in the article is, "We must bear in mind that the ordinary assumption explains these as arising from differences in barometric pressure due to differences in temperature, while M. Rougerie bases his theory on differences in air pressure directly due to the rotation." This seems to imply that his theory is deemed a new one.

Professor William Ferrel, who was connected for many years with the United States Coast Survey, and then with our national weather bureau, from which he withdrew on account of ill health only a few months ago, was the first to apply to meteorology the principle that M. Rougerie illustrates now so ingeniously. His paper on "The Motions of Fluids and Solids on the Earth's Surface" was published in *Runkle's Mathematical Monthly* during the years 1858 to 1860, the general course of reasoning employed by him having been first given in a popular article, published in 1856, in the *Nashville Journal of Medicine and Surgery.* It was reprinted in 1882 as No. VIII. of the professional papers of the United States Signal Service. It bristles with mathematical equations, and probably on this account the results attained by him have not found their way into the popular text-books. Professor Guyot was probably familiar with them, but did not undertake to popularize them in his school text-book of physical geography, which is largely used in this country. In all of the text-books on this subject, the rotation of the earth is taken into account in explaining the westward tendency imposed upon the fluids at the earth's surface in equatorial regions, and the eastward tendency as they return toward the poles, this deflection being from motion in a north and south line.

Professor Ferrel showed that "*in whatever direction* a body moves on the surface of the earth, there is a force arising from the earth's rotation which deflects it to the right in the northern hemisphere, but toward the left in the southern." The usual explanation of the trade winds is an application of only a part of Ferrel's law. This law includes what M. Rougerie illustrates with his anemogene. It is the foundation for the explanation of not only the trade and anti-trade winds, but of the currents of the ocean and of the spiral motion of the air in cyclones. The fact of such spiral motion is always mentioned in the school text-books, but there is usually very little in the way of explanation of this or of their approximately parabolic path.

In the article about M. Rougerie, it is stated that "somewhat fancifully he assumes, in analogy with the rings of Saturn and the belts observed on Jupiter, that our atmosphere extends to a greater height at the equator than at the poles, so that the earth should carry with it a sort of atmospheric ring." This "fancy" was, thirty years ago, developed mathematically by Professor Ferrel, whose conclusion that the poles must be regions of relatively low barometric pressure has been verified by subsequent observation, as may be seen by examining any recent isobaric chart of the world. The truth is not that Wojeikof's observations are explained by Rougerie's subsequent theory, but that they were preceded by Ferrel's general demonstration.

Important as the earth's rotation is in determining the fluid currents at its surface, its effects are so bound up with those due to the sun's heat that no separation is possible. Nor can we ever decide whether Rougerie is right in according to the sun's rays "only the second place."

M. Rougerie is not alone in having constructed a model to show the effect of rotation, along with continental interference, in producing currents that circulate somewhat irregularly over the earth's surface. As far back as 1866, I saw one in which the fact was satisfactorily demonstrated. W. LE CONTE STEVENS.

Brooklyn, March 24, 1887.

The New Thames Tunnel.

A representative of the *Pall Mall Gazette* having visited the new tunnel in course of construction between the Monument and the Elephant and Castle, gives the following account of this remarkable work :

One striking feature of the new subways is their depth. They run right down underneath water and gas mains and sewers, and almost wholly keep to the line of the public thoroughfares, so that the projectors are not handicapped by heavy compensations, at one point only payment having been made. The depth under the roadways ranges from 40 feet to 45 feet, and under the Thames it is about 15 feet. Starting from the terminus, which will have a commanding corner position immediately above the Monument, the tunnels extend across the road, and passing down Swan Lane, they enter the river bed at the Swan pier, about 50 yards above London Bridge. There are two independent tunnels, one for the up and the other for the down traffic, and as Swan Lane is very narrow, there was no space to place them side by side without encroaching on the contiguous property. The engineer has overcome the difficulty by running one over the other with about 5 feet of earth between, and gradually the lower one is raised until they run parallel, but separated by about 5 feet.

The work is being carried on from a temporary shaft sunk at the Swan pier, with a depth of 60 feet to the first tunnel and 75 feet to the second, and having a diameter of 13 feet. Down this shaft we were swung, and at the bottom we found ourselves in a long iron cylinder 10 feet in diameter. At present it is dimly lighted with gas and lamps, but we could see ahead for a considerable distance, the tunnel taking a straight line. A temporary tramway for the removal of the excavated material, and for carrying forward the iron plates with which the cylinder is built up, runs along the whole length of the subway. We found the path somewhat treacherous, for the passage of the greasy clay had made the boards very slippery. We arrived at the extremity, however, without mishap, and in a slightly heated atmosphere watched operations.

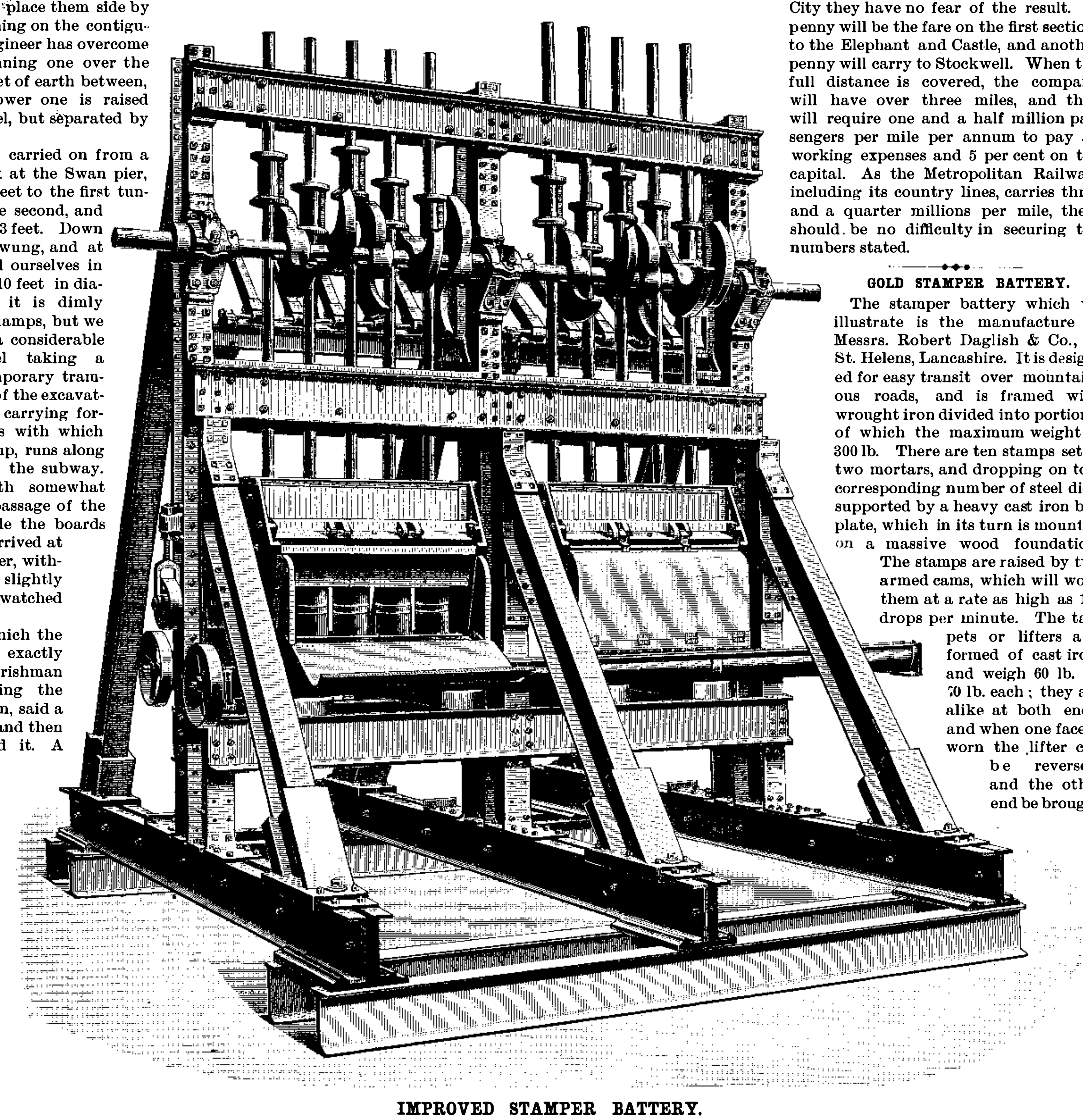
The principle on which the tunnel is made was exactly pictured by the Irishman who, when describing the manufacture of a gun, said a hole was first made and then iron was put round it. A hole is cut into the clay, and then piece by piece the cylinder is built up. And in this connection it may be noted that the London clay through which the subway will run its whole course is admirably adapted for the work, but at the same time sand or other loose soil can also be tunneled with a slight change in the machinery and method. First of all, a small heading is driven into the clay, and supported by timbers. With pick and shovel about 18 inches of the soil to the extent of the tunnel's circumference is next taken out, and then the "shield," as it is termed, begins work. This might be likened to the cap of a telescope, the telescope itself representing the tunnel in which the men are at work. Steel cutters are fixed round the outer edge of the cap (to maintain the simile), and hydraulic pressure (500 lb. to the square inch) is brought to bear upon it from within, driving it into the clay. The hole which was partially made by hand labor is thus rounded off, and the "shield" has been pushed forward in less than a quarter of an hour 18 inches. The "cap" is not wholly off the telescope, however. A plate of iron affixed to the "shield" covers the space bored until another section of the tunnel is added. Thus section after section is built up as the progressive movement is effected.

The circle is made up of six pieces, with a key piece at the top. They are 18 inches wide and 1 inch thick, with flanges through which they are securely bolted together, and weigh about 4¼ cwt. each. The metal is cast iron, which will not corrode. The tube fits exactly to the shape of the hole which the "shield" has cut, less the thickness of the iron plate which the cap of the telescope typifies in the description. As the shield goes forward this hollow is filled with "grout" or liquid lime, which is forced through a hole in the iron plate by pneumatic pressure, and it very soon solidifies. There can thus be no risk of instability by the subsidence of the soil. In the matter of strength the engineer gave it as his opinion when the bill was before Parliament, the question of weakening the foundations of London Bridge having been raised, that forty London Bridges piled on the top of each other would not damage the cylinder.

Something like 10 feet can be driven each day, and in sixteen weeks the Thames was tunneled. The contrast with the ancient methods is amazing. The first Thames tunnel occupied about eighteen years, and although recent works have been more expeditiously completed, they have been much more prodigal of time than the one under review. The cost, also, can bear no comparison. 200,000*l*. per mile is regarded as the ultimate cost, and including stations, land, and indeed every outlay, the authorized line of 1½ miles will be completed for 300,000*l*. Hydraulic lifts will raise and lower the passengers at the stations, of which there are to be three, the intermediate one being at St. George's Church in the Borough, where the car traffic for the City is emptied. If the extension beyond the Elephant and Castle is approved, stations will be placed at Kennington Park, Kennington Oval, and the terminus at Stockwell. This would add 1¾ miles to the line, which would mean an additional outlay of 250,000*l*., or 550,000*l*. in all for 3¼ miles.

All the details of working the line are not complete, but trains of three or four carriages somewhat after the style of a tram or Pullman car will be run, the motive power being the endless cable. The cars will be more roomy than omnibuses or even ordinary railway carriages. A driver and conductor will be in charge of each train, which will carry about one hundred passengers. The carriages will be about 6 inches from the top of the tunnel, and about 1 foot 6 inches, measured from the center, at the sides. They will start every two or three minutes, and the distance over the first section will be covered in six or seven minutes. The speed will be about double that of road conveyances. The machinery for working will be placed at the Elephant and Castle. With respect to ventilation, the engineer anticipates no difficulty. There will be no foul smoke from engines, as in the case of the underground, and, as the trains in each tunnel will always be running in one direction, they will create a current of air. If that, however, is not thought sufficient, a fan can be placed at the intermediate station, and by the expenditure of one horse power the atmosphere in the whole of the subway can be changed every hour.

The promoters of the line, of course, believe it will pay. They are going in for cheap fares and fast conveyance, and with the enormous traffic to and from the City they have no fear of the result. A penny will be the fare on the first section, to the Elephant and Castle, and another penny will carry to Stockwell. When the full distance is covered, the company will have over three miles, and they will require one and a half million passengers per mile per annum to pay all working expenses and 5 per cent on the capital. As the Metropolitan Railway, including its country lines, carries three and a quarter millions per mile, there should be no difficulty in securing the numbers stated.



IMPROVED STAMPER BATTERY.

GOLD STAMPER BATTERY.

The stamper battery which we illustrate is the manufacture of Messrs. Robert Daglish & Co., of St. Helens, Lancashire. It is designed for easy transit over mountainous roads, and is framed with wrought iron divided into portions, of which the maximum weight is 300 lb. There are ten stamps set in two mortars, and dropping on to a corresponding number of steel dies, supported by a heavy cast iron bed plate, which in its turn is mounted on a massive wood foundation. The stamps are raised by two armed cams, which will work them at a rate as high as 110 drops per minute. The tappets or lifters are formed of cast iron, and weigh 60 lb. to 70 lb. each ; they are alike at both ends, and when one face is worn the lifter can be reversed, and the other end be brought into use. The stamp head or socket is cylindrical, and is strengthened by wrought iron bands shrunk on. The stems run through guides of green-heart timber constructed in halves, so that they may be adjusted for wear.

The crushed ore, in the dry process, passes through screens of woven wire, varying in fineness from 900 to 10,000 meshes per square inch ; in wet working, the screens are plates perforated by punches varying in size from No. 0 to No. 10 common sewing needle. The crushed ore falls into worm conveyers, by which it is delivered to whatever type of amalgamating apparatus may be employed. The conveyers are driven by a belt which is kept taut by a tightening pulley.

The perspective view shows the stamper framed in the makers' shops in this country, while the detail views illustrate the additional timber work to be fitted to it at the mine.—*Engineering.*

THE body of a nine-year-old girl has recently been cremated at the crematory near Pittsburg.