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THE 42D STREET SEWAGE TUNNEL, NEW YORK CITY.

The facility with which underground tunnels can be made beneath the streets of New York is strikingly exemplified in the boring of the now nearly completed tunnel which passes under East 42d street from between 3d and 2d avenues to the East river. The excavation has been made for sewerage purposes, and were it not for the small area of thoroughfare occupied by the enclosure about the shaft openings and the surface machinery, no one would be aware, so far as outside indications go, that the work was in progress. The cutting of 42d street through Prospect Hill is simultaneously proceeding, and while this extensive operation has been carried on on the surface, the tunnel has been run many feet below, so that most people, not being informed of the tunnel's existence, naturally infer that all the machinery, etc., visible, relates to the opening of the upper cut. So far as producing discomfort to the neighborhood is concerned, the last-mentioned work has proved a serious annoyance, and although when finished it will materially enhance the value of property, since its beginning it has rendered neighboring houses almost unrentable. The tunnel, on the other hand, while likewise benefiting property, has been productive of no inconvenience whatever.

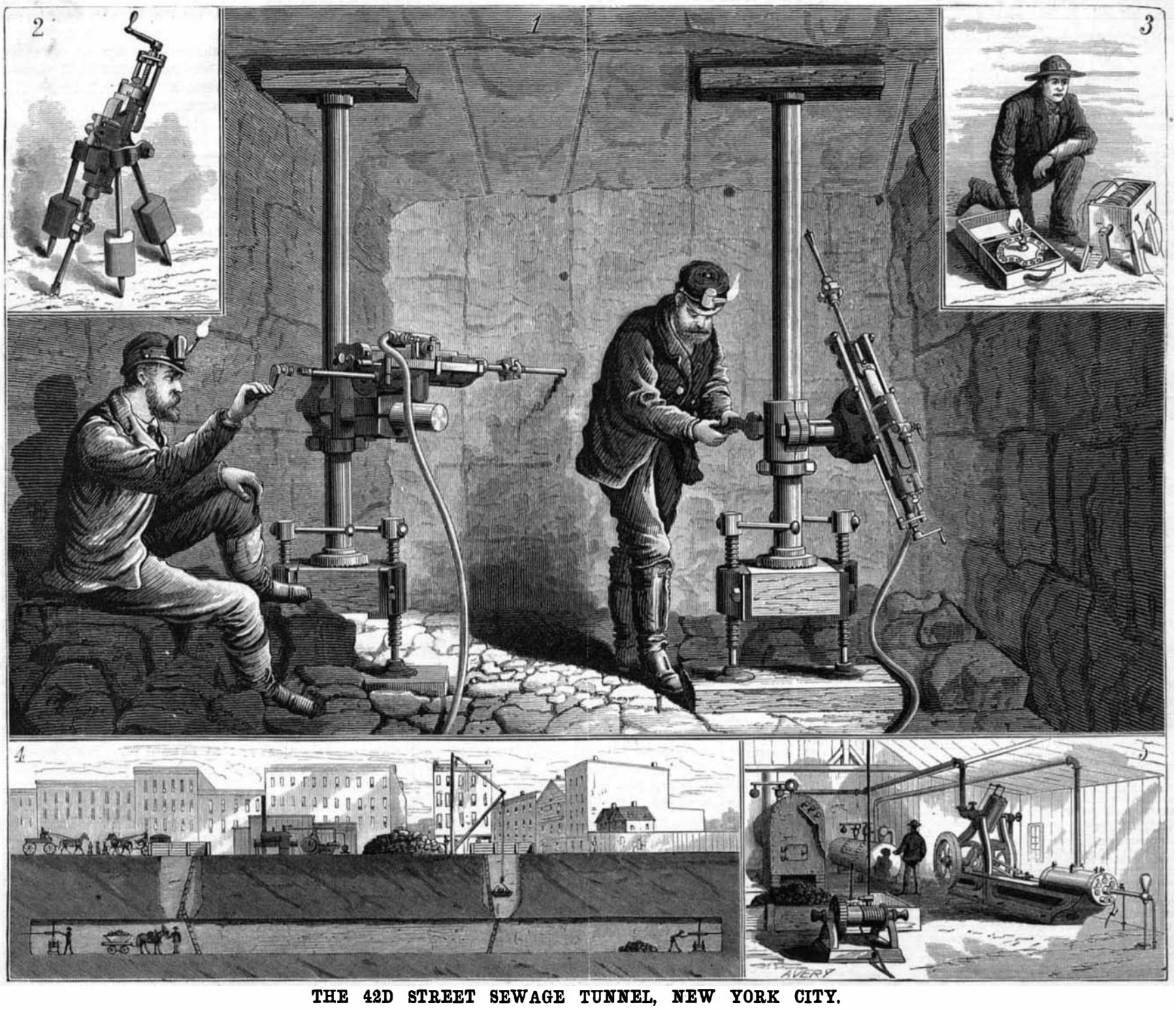
There is another remarkable feature about the subterranean work, and that is the rapidity with which it has been executed. It is eight feet square in section, and to be eighteen hundred feet in length. Twelve hundred feet are now finished, and have been accomplished in the short space of seven months. The rock is gneiss and quartz, and the machinery employed is the Rand Little Giant rock drill, driven by compressed air supplied by the Rand & Waring compressor. Five drills have been used, three constantly in action and two under repair. Fourteen holes are made in the headings before blasting, and the average advance is 6 feet per hole in 10 hours.

In the accompanying engraving we illustrate the Rand drill in operation in Fig. 1, the drill separately in Fig. 2, the exploding battery for firing blasts, Fig. 3, a section of the tunnel under 42d street in Fig. 4, and the interior of the compressor house, showing the compressor, etc., in Fig. 5. The compressor consists of a steam cylinder and its piston connected with a double-acting compressing cylinder and its piston, the connection being made to one and the same revolving shaft by a crank pin common to both. The steam end consists of an oscillating steam engine placed obliquely and so arranged that at the moment of greatest resistance of the compressed air, the greatest effort of steam is applied. The air compressing cylinder is composed of three concentric shells, which form two annular spaces around the working cylinder; the outer space affords a passage for the air after compression, and also a vessel for collecting any moisture that there may be in the air; the inner space forms passages for the water used in cooling. The heads of the cylinder, the piston and piston rod, are also hollow, to admit a flow of water through them. The essential feature of the entire machine is the system of circulation, which places a current of flowing water behind every part of the compression machinery with which the air comes in contact during compression, while cold water is continually supplied as fast as it is required.

The principal point in the construction of the Rand drill is its simplicity. It is claimed to have a less number of parts than any other machine of its class. By a simple device the valve is thrown in the same direction as the piston is moving, without the use of a connecting rod, or any cumbrous machinery outside the steam chest or cylinder, thus obviating the constant stoppages for replacement. The port is not closed until the drill has made the full stroke, thus bringing to bear the full force of air or steam in doing the required work.

The drills are intended to be used with either the column or tripod. In vertical work the latter is more suitable. Its legs are arranged to telescope, and can be lengthened or shortened at will, thus allowing holes to be bored in very difficult places and at almost any angle. Another advantage claimed for the drills possess over the old system of hand work, is not only in the economy of time and labor, but in the saving of material used. The drill, or bit, being an integral portion of the blow-delivering power, is exhausted only at one end instead of having both flattened—one by the resistance of the rock and the other by the powerful blows from a sledge hammer, which last itself enters into the list of materials consumed.

The Rand drills weigh from 150 to 900 lbs., there being six sizes, the smallest drilling from ½ to 1 inch holes, and especially for plug and feather work, the largest boring 3 to 4 inch holes, 30 feet deep, and intended for deep cuts, large apertures, and the heaviest class of rockwork. The machines may be driven by either steam or compressed air, but the tunnel above referred to is an instance of the advantages attending the use of the latter underground. In so confined a space, where there is no exit for the exhaust steam, it would be practically impossible for men to work;



THE 42D STREET SEWAGE TUNNEL, NEW YORK CITY.

compressed air, on the contrary, suffers no such diminution of pressure on being carried over long distances, as does steam; and its escape serves to ventilate the tunnel.

The Rand drill is in use in a large number of mines, etc., throughout the country, notably those in Port Henry, N.Y. the Comstock mine in Nevada, the Lehigh and Wilkesbarre Coal and Iron Company's mines in Nevada and elsewhere. For further information relative to both drills and compressors, address

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(Illustrated articles are marked with an asterisk.)

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$80,000 REWARD FOR A CURE FOR CHOLERA.

By a will dated August 28, 1849, a French gentleman named Bréant left to the Paris Academy of Sciences the sum of $80,000, to be awarded as a prize to any person who should either discover a cure for Asiatic cholera, or the cause of the disease. He further directed that the interest of this fund, until the principal was finally awarded, should be donated as premiums to investigators who should contribute important information tending to advance knowledge relative to the malady. The rules of the French Academy, under which the prize will be awarded, are as follows. The competitor is required:

(1). To point out a system of medicine that cures cholera in the immense majority of cases; or

(2). To indicate, in an incontestable manner, the causes of Asiatic cholera, so that, by suppressing these causes, the epidemic will cease; or

(3). To discover some certain prophylactic as evident for cholera, as, for instance, vaccine is for small-pox.

(4). To become entitled to the annual prize (derived from *the interest* on the $80,000), the competitor will have to demonstrate, by rigorous processes, the existence in the atmosphere of substances that may play a part in the production or propagation of epidemic diseases; and

(5). In case none of the above conditions have been fulfilled, a competitor may take the annual prize by finding a radical cure for tetters, or enlightening the world upon the etiology of that disease.

The existence of this reward has been the cause of an immense amount of medical research, and hundreds of papers have been submitted to the Academy. The great prize has never been awarded, and probably it never will be, for before the cause or the cure of Asiatic cholera can be discovered, the malady itself, owing to our constant progress in knowledge of preventive sanitary precaution, will probably, like the plague, have disappeared altogether.

During the present year, we learn from the English *Magazine of Pharmacy*, nine papers have been sent in. None have been adjudged worthy of the $80,000, but as the interest may be bestowed annually upon any person "who shall have caused science to progress, as regards cholera or any other epidemic disease, either by giving better analyses of the air, and showing therein some morbid element, or by discovering some process enabling us to become acquainted with, or investigate, the animalculæ which, up to the present time, have escaped the eyes of the learned, and which may be the cause, or one of the causes, of the disease."

Portions of the revenue have been awarded—on two of the nine papers. The first of the successful pair is by Dr. Duboué, of Pau, and he endeavors to demonstrate that the primitive lesions consist in a disquamation of the endothelium of the small vessels, and of the epithelium of the various membranes, particularly that of the intestine, and he attributes this disquamation to the influence which the morbific agent of cholera, after it has penetrated into the system by the capillaries of the lungs, exerts upon the epithelial cells and the intercellular substance. For explanation of the various phenomena of cholera, according to this theory, Dr. Duboué was awarded a prize of $400. The other fortunate competitor was Dr. Stanski, of Paris, who forwarded a large number of pamphlets, wherein he endeavored to demonstrate that contagion at a distance by miasma, or, in other terms, infection by means of a volatile principle, has no existence in any disease whatever. For this contribution a prize of $200 was given.

We believe that the existence of this prize is little known in this country, and as cases of cholera have been of frequent occurrence in some localities South, and also have been closely and intelligently studied by the physicians of that section, we have no doubt but the American medical profession, if it does not possess some member who may secure the prize, at least numbers many who can contribute materially to general knowledge concerning the disease.

SUN SPOTS STUDIED BY SOLAR PHOTOGRAPHY.

M. Janssen has obtained magnificent photographs of the sun, measuring some 12 inches in diameter, on which the granular solar surface can be as clearly distinguished as by regarding the sun through the largest instruments. He obtains these by diminishing the time of exposure to less than $\frac{1}{300}$th of a second and employing special means for the development of the image.

On April 14th last, M. Janssen states that a photograph of the sun showed no spots, and it was therefore reasonable to presume that none existed, as spots as small as one second in diameter were always registered. On the next day, at about 8 A.M., another photograph showed, near the center of the sun, a considerable group of spots, the largest of which measured some 20 seconds in diameter. M. Janssen points out that, as the earth when seen from the sun is but 18 seconds in apparent diameter, our globe could easily have been contained within the area of the largest spot. The suddenness of the apparition and the grandeur of the phenomenon led the observer to predict the prompt disappearance of the spots and frequent changes in their configuration. He further concluded that the idea that, when the sun (as at present) exhibits few spots, that it is undergoing a period of repose is inexact, but that the truth is rather the reverse, as spots then form and vanish with a rapidity much greater than at any other epoch.

Of course these views of M. Janssen have led to many observations and much discussion by and among astronomers. M. Denza cites a small spot which appeared on March 6th and disappeared before the 12th; the same observer notes the fact that the spot of April 15th formed on the afternoon of the 14th. M. Ventosa at Madrid also saw the spots form at 5 P. M., on the 14th, and mentions seeing other smaller spots appear and vanish rapidly during previous months.

M. Gazan dissents from M. Janssen's views, and regards sun spots as the result of eruptions in the solar mass. Before the spot, however, there are faculæ which should have been seen. In the photograph of April 14th, however, faculæ are altogether absent, but this M. Gazan explains by assuming that the faculæ were too near the center to be visible. According to him the spot in question will not disappear any more rapidly than spots during the maximum epochs, and he thinks that it will return. M. Janssen, however, replies that fifteen days afterward, when the sun had more than completed his semi-rotation, the spot should, according to M. Gazan, have reappeared, whereas it did not.

M. Tacchini does not coincide with M. Janssen in the idea of the present activity of the sun, but on the contrary considers that an actual period of repose exists. He points out that there were 290 spots observed within five months in 1871, while but 24 were noted in the same period in 1876.

M. Janssen states that the first mentioned total is exaggerated, for several spots which appeared three or four times were counted as frequently, and that numerous small spots could not appear and disappear rapidly, as is the case now, without producing excessively violent movements in the solar mass. This very great activity would militate against the formation of spots and be favorable to the disappearance of those already produced.

CEREBRAL THERMOMETRY.

At a recent meeting of the French Medical Association at Havre, M. Broca laid before it the results of a prolonged investigation into the temperature of the surface of the head in health and disease. He employed an instrument of which the bulb was maintained in contact with the cranium, whilst its opposite surface was thoroughly insulated from external air. As a rule, he placed three of these thermometers on each side of the head, and thus obtained readings at six different points. A normal standard was obtained by experiment from healthy individuals. Twelve persons were taken. The maximum temperature was 94·73° F., the minimum 91·04°, giving a mean temperature of 92·87.° The thermometers on the left side registered two degrees higher than those of the right, when the brain was passive; when active an equilibrium was at once established. From this, Mr. Broca inferred that the blood supply is more abundant to the left than the right hemisphere; but when the brain is called into activity, the right hemisphere, being, as it were handicapped, calls for a greater supply of blood than the left. The reading of a book raised the temperature one degree.

LESSONS IN MECHANICAL DRAWING.

The very admirable series of Lessons in Mechanical Drawing which have been serially published in the SCIENTIFIC AMERICAN SUPPLEMENT is now approaching its termination. The first of these lessons appeared in No. 1 of the SUPPLEMENT and in it the author, Professor C. W. MacCord of the Stevens Institute (himself perhaps the ablest mechanical draughtsman in the country) entered upon his subject in a manner not only entirely novel but in a way which could not but prove to the student that the subject was to be treated with a comprehensiveness and thoroughness never before attempted in any work, and certainly never essayed in any periodical journal. Professor MacCord began by teaching the beginner how to make his own instruments, starting out with a couple of triangles to be cut out of pasteboard, and showing how much might be done with these simple aids. Then followed instructions how to make lines and angles and to combine them into various geometrical patterns. In lesson 7, he reached the employment of the compasses and the first introduction of circular forms, and thus he proceeded, taking up the various instruments and clearly elucidating their uses. The first thirty-two lessons completed the elementary portion; and whoever had mastered the principles and faithfully practiced the exercises presented in the large number of drawings, which were accurately prepared by the author himself, was then in a position to place the knowledge acquired of mechanical drawing to the test of practical application in its legitimate sphere, namely the actual draughting of machinery. The new series began with the draughtsman's scale and its uses, and the learner was at once inducted into the drawing of simple forms, such as bolts, nuts, links, and all the various parts of machines and so onward until in the most recent lessons the construction of the screw propeller has been elucidated.

That the lessons have proved of practical value we have the direct evidence of a number of correspondents who have written to us telling us of their progress, and also by their questions showing how intelligent an interest they feel in the same. Some have sent us capitally executed drawings as proof of their attainments. One writer informs us that he has practised but for two months on the lessons extending to No. 5 in the second series, and that, although he had no previous knowledge of draughting, he has acquired sufficient skill to enable him to prepare patent office drawings, so that he now is making money out of the valuable education he has obtained from the SUPPLEMENT's pages.