a second after ceasing fire this would continue, so that a charged wing could be brought up to the lever, the shells ejected, and the fire reopened by the time the last missile of the previous charge had struck. The inventor concludes that, virtually, a continuous and unceasing stream of bullets may be kept up by the crank fire, for any desired length of time.

To Mr. J. P. Taylor of Tennessee is due the credit of this very ingenious weapon, of the successful operation of which we have assured ourselves by personal observation. In the experimental battery, an excellent piece of mechanical work from the shops of the Holske Machine Works in this city, from which our engravings were made, we remarked but few points that were susceptible of simplification, and we could suggest nothing which had not been anticipated by the inventor and fully provided for in a second gun which we learn he is about to construct. The piece has already attracted no small degree of attention in military circles, and we do not doubt but that it will excite even a greater interest when it appears, as we understand it will, according to the intention of the inventor, at the Vienna Exposition. Further and more detailed particulars may be obtained by addressing J. P. Taylor, patentee, or D. Hockett, attorney, Knoxville, Tenn.

Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year - - - - - - - - $3 00
One copy, six months - - - - - - - - 1 50
CLUB RATES { Ten copies, one year, each $2 50 — 25 00
Over ten copies, same rate, each — 2 50

VOL. XXVIII., No. 17. [NEW SERIES.] *Twenty-eighth Year.*

NEW YORK, SATURDAY, APRIL 26, 1873.

Contents:

(Illustrated articles are marked with an asterisk.)

THE SOURCES OF OUR MODERN KNOWLEDGE.

In the uncertain prehistoric ages during which the ancient human civilization was evolved, Science, which regulated the social relations, did not rise above the purely material purposes which occupied the minds of men. The small number of truths, of which Science then consisted, were only empirical deductions from facts; but she advances with the progress of humanity, and from Thales to Archimedes immense scientific labors extend her limits and tend to generalize human knowledge.

Thales, who lived twenty-six centuries ago, is one of the first philosophers, known to us, who brought his knowledge to a systematic whole. He was the founder of the Ionic school in Greece, and was equally successful as a mathematician and an astronomer. The school founded by him was afterward split up into different sects, which embraced in their researches all branches of human knowledge.

Pythagoras then appeared; this philosopher, who by grateful mankind of his age was called "divine," extended the domain of the mathematical sciences, and the tradition that he sacrificed one hundred oxen to the gods, from gratitude for the discovery of the famous problem which bears his name, is a proof of his trust in the guidance of a superior power. He had clearer notions than his successors; he taught the globular form of the earth, of which Anaximander had not the least idea, and he described the earth's motion around the sun; but mankind was not yet able to grasp this truth, and it had to be elaborated for two thousand years before general recognition of it was obtained.

After Plato, who, 2,200 years ago, had above the door of his lecture room the words "Nobody can enter here who is no geometrician," came the great Euclid, and then the illustrious Archimedes, the greatest philosopher of his time, who solved the most advanced problems with all the might of genius. The works of Apollonius, Hipparchus, Ptolemy, Diocletian, etc., fill up this earlier period of scientific history; but the authors are more specialist than universal philosophers; however, they contributed powerfully to the progress of knowledge.

At the beginning of a second period, Science seems to have been suddenly arrested, and ceases to appear as an element in the regeneration of humanity. She sheds, however, some of her light in the school of Alexandria; but after Diophantes her lamp appears to be everywhere extinct. Several centuries later, Science revives and is given back to the world by the same people that once slew her in her last asylum, and surrendered the celebrated library of Alexandria to the flames, a library which contained all the philosophical works of preceding ages.

If the Arabs gave back to Europe, during the middle ages, some of the sciences, the records of which they destroyed in Alexandria, Europe in her turn became not only a rival, but a far superior master in the advancement of philosophy. It was then that Science took possession of certain grand theories, of which the preceding ages had scarcely any presentiment; the war which thus far had only existed in the moral world was carried into the scientific field; and human intelligence had begun to crave the discoveries developed by examination and discussion in the realm of positive sciences. It was then that Luther defended freedom in the examination and discussion of moral principles, and Copernicus defended freedom in scientific research, and established the true astronomical system. Then a galaxy of great men appeared: Italy produced Galileus Galileo; Germany, Gottfried Leibnitz; Holland, Christian Huyghens; England, Isaac Newton; and France, Rénate Descartes. Since that time discoveries have succeeded discoveries with the most unexampled rapidity; and thanks to their practical tendency, the appearance of the surface of our earth has changed during the two centuries since the time of these great men more than in the two thousand years previously. The number of discoverers and promoters of progress of the present day is indeed too great to enumerate, and what is a most striking fact, it has been steadily increasing during this century. In regard to the discoveries themselves, it appears to be reserved for the end of this century to place the crown on the now magnificent edifice of human knowledge, the labor of so many centuries, by a mighty doctrine which reunites all the isolated and various phenomena, by deducing them from a single absolute principle, the main object of modern research: The conservation of force or motion, which is founded on the principle of universal gravitation.

THE BROADWAY UNDERGROUND RAILWAY.

The bill for an underground railway beneath the great thoroughfare of New York city, known as Broadway, has finally passed both branches of the State legislature, received the Governor's signature, and become a law. The wonder is, in a community like this, so noted for the number of its intelligent, active, and vigorous men, that such an important enterprise should have been so long postponed. No city in the world has more pressingly needed the facilities for rapid transit than New York.

It has always been conceded that the best route for a fast railway was under the surface of Broadway. The peculiar formation of the metropolis, very narrow, surrounded on two sides by deep rivers, permits the movement of its population along one general line only—towards the north. The splendid thoroughfare of Broadway, seventy-five feet in width, lies in the very center of this movement, forming in fact the backbone of the city. Business of all kinds has Broadway for its focus, and probably no other street in the world is so constantly thronged with passengers and vehicles. The value of property on Broadway has become very great, and it is lined with many noble and costly edifices. Its peculiarly central position, the ease of its grades, the firmness of its soil, to say nothing of its enormous traffic, have always marked it as the natural route for an underground railway; and many different companies of railroad builders have vainly attempted to secure it as a prize. The property owners on the street, comprising many of our most wealthy and influential citizens, have always, until recently, opposed the railway, and nobody appears to have had wit or power enough to overcome their opposition.

The grounds for their hostility were plain and simple. They alleged that the operation of digging for the railway would endanger the water mains, break up the sewerage, set the gas pipes leaking, and tumble down every building on the street; causing a thousand times more damage and mischief than all the underground railways in the world were worth. This idea, in whole or in part, has pervaded the minds of owners and so united them in purpose that whenever any persons made a movement for the railway, they met with formidable opposition and signal defeat. Many and memorable have been the contests in the State legislature on the subject, and immense the sums of money expended; but the property owners invariably triumphed. In vain were they told that London had built such a railway and property, instead of being injured by it, was improved. To this it was replied that New York was not London, and that a road built here would certainly destroy the houses. For fifteen years has this sort of nonsense been allowed to bear sway, while the people suffered for want of the railway; and by reason of its lack thousands of families and business establishments were driven out of the State into New Jersey.

Our readers are familiar with the details of the construction of the short experimental section of railway under Broadway, by the Beach Pneumatic Transit Company. They will remember how this tunnel was bored by mechanism, under the surface of the pavement, below the water pipes, sewers, gas pipes, and foundations of adjoining buildings, the enormous traffic of the streets going on as usual, directly over the heads of the diggers. The public had no knowledge of the work until it was finished, and were greatly pleased with the quiet but effective manner in which it was done. That tunnel has been in existence and the experimental railway has been in operation for three years, presenting at all times an unanswerable argument in favor of an enlarged railway, and a practical refutation of the frivolous reasoning of the property owners. Meantime the company asked from the legislature the privilege of enlarging and extending the work, so as to provide a first class underground railway, and the public gladly seconded their request. For three years the company have pressed their enterprise upon the attention of legislature, and have at last succeded. Their charter is secured. Their aim now is to make the work the model of its kind. The railway is to extend under Broadway, Madison avenue, and Harlem river to Westchester county, nine miles, with an additional lateral branch. The work of construction is to be done under the supervision of State engineers. Stringent provisions are made by law to guard all public and private interests.

We shall, from time to time, present such information concerning the progress of the work as may be of interest to our readers. The office of the company is at No. 260 Broadway, corner of Warren street, and all communications should be addressed to the Secretary, Joseph Dixon, Esq.

THE FIRE ON BOARD THE STEAMER ALASKA.

We recently published a communication from Mr. Norman Wiard, giving us the particulars of the ignition, by "over heated steam" as he alleged, of the felting of one of the boilers of the United States steamer Alaska. The report of this fire was sent to us by Mr. Wiard for the purpose of vindicating his theory of "ignition by superheated steam" from the charge of being "absurd," as criticised in the SCIENTIFIC AMERICAN, and also for the purpose of placing before our readers a positive example of such ignition, the facts concerning which might be examined and verified by any one who so desired: the previous examples referred to by Mr. Wiard not being open to such examination.

It appeared to us when we published Mr. Wiard's last letter that the fire on board the Alaska could not have been caused by overheated steam, and we then gave our reasons for so thinking. We will now present further information concerning the fire in question, derived from an authentic source, which completely upsets Mr. Wiard's superheated steam theory.

We give a diagram showing the general form of the boilers of the Alaska, and the arrangement of the superheating tubes. The steam passes from the boiler into the superheater and thence to the engine in the usual manner. We also give a diagram on an enlarged scale of the upper portion of the boiler and superheater at the junction with the uptake. It was at the corner *A*, where the uptake begins, that the felting took fire, and the ignition was occasioned by the contact of the felting with the uptake. The felting had very improperly, been packed against the uptake, the heat of which finally produced ignition. Neither the boiler proper, the superheater, nor "overheated steam," had any thing to do with the fire, and so Mr. Wiard's superheated steam theory is again shown, by the facts in the very example he adduces, to be absurd.

Fig. 1.

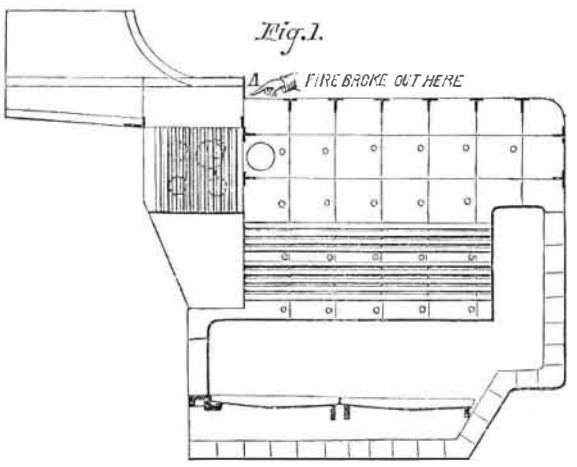
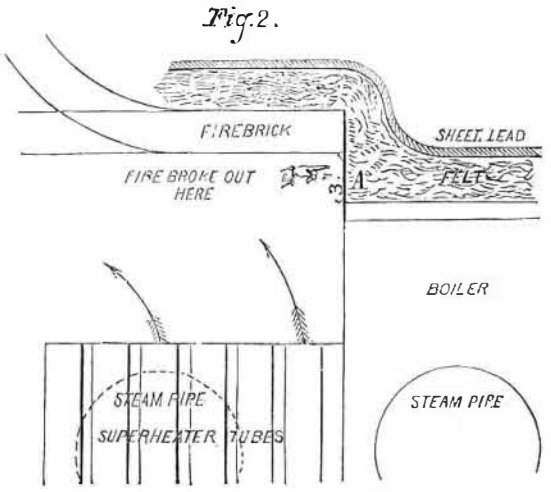


Fig. 2.



We trust that the fire on the Alaska will serve as a warning to engineers, and others who are charged with the duty of clothing boilers, to use proper care in such matters. The felting should never be packed against the uptake or chimney, as in this case. We are glad to know that since the fire the proper precautions have been taken on board the Alaska to prevent a recurrence of a similar disaster. The felting