THE AMERICAN TORPEDO BOAT OF 1776.

The historical records of our Revolutionary war contain notices of the attempt made in 1776 to destroy the British fleet then anchored in the harbor of New York, by means of a submarine apparatus. The following details of the construction of the torpedo vessel, its operations and final loss, are from the pen of the inventor himself, D. Bushnell, of Connecticut, and were communicated by him many years ago, to the American Philosophical Society, from whose records we transcribe them. This we believe was the first submarine boat ever constructed. Every part seems to have been well considered, and the whole exhibits a degree of ingenuity quite remarkable for those early days of invention.

The external shape of the submarine vessel bore some resemblance to two upper tortoise shells of equal size, joined together; the place of entrance into the vessel being represented by the opening made by the swell of the shells, at the head of the animal. The inside was capable of containing the operator, and air sufficient to support him thirty minutes without receiving fresh air. At the bottom, opposite to the entrance, was fixed a quantity of lead for ballast. At one edge, which was directly before the operator, who sat upright, was an oar for rowing forward or backward. At the other edge was a rudder for steering. An aperture, at the bottom, with its valve, was designed to admit water, for the purpose of descending; and two brass forcing-pumps served to eject the water within, when necessary for ascending. At the top there was likewise an oar, for ascending or descending, or continuing at any particular depth. A water gage, or barometer, determined the depth of descent, a compass directed the course, and a ventilator within supplied the vessel with fresh air, when on the surface.

The entrance into the vessel was elliptical, and so small as barely to admit a person. This entrance was surrounded with a broad elliptical iron band, the lower edge of which was let into the wood of which the body of the vessel was made, in such a manner as to give its utmost support to the body of the vessel against the pressure of the water. Above the upper edge of this iron band there was a brass crown, or cover, resembling a hat with its crown and brim, which shut watertight upon the iron band; the crown was hung to the iron band with hinges, so as to turn over sidewise, when opened. To make it perfectly secure when shut, it might be screwed down upon the band by the operator, or by a person without.

There were in the brass crown three round doors, one directly in front, and one on each side, large enough to put the hand through. When open, they admitted fresh air; their shutters were ground perfectly tight into their places with emery, hung with hinges, and secured in their places when shut. There were likewise several small glass windows in the crown, for looking through, and for admitting light in the day time, with covers to secure them. There were two air pipes in the crown. A ventilator within drew fresh air through one of the air pipes, and discharged it into the lower part of the vessel; the fresh air introduced by the ventilator expelled the impure light air through the other air pipe. Both air pipes were so constructed, that they shut themselves whenever the water rose near their tops, so that no water could enter through them, and opened themselves immediately after they rose above the water.

The vessel was chiefly ballasted with lead fixed to its bottom; when this was not sufficient, a quantity was placed within, more or less, according to the weight of the operator; its ballast made it so stiff, that there was no danger of oversetting. The vessel, with all its appendages, and the operator, was of sufficient weight to settle it very low in the water. About two hundred pounds of the lead, at the bottom for ballast, would be let down forty or fifty feet below the vessel; this enabled the operator to rise instantly to the surface of the water, in case of accident.

When the operator would descend, he placed his foot upon the top of a brass valve, depressing it, by which he opened a large aperture in the bottom of the vessel, through which the water entered at his pleasure; when he had admitted a sufficient quantity, he descended very gradually; if he admitted too much, he ejected as much as was necessary to obtain an equilibrium, by the two brass forcing pumps, which were placed at each hand. Whenever the vessel leaked, or he would ascend to the surface, he also made use of these forcing pumps. When the skillful operator had obtained an equilibrium, he could row upward, or downward, or continue at any particular depth, with an oar, placed near the top of the vessel, formed upon the principle of the screw, the axis of the oar entering the vessel; by turning the oar one way he raised the vessel, by turning it the other way he depressed it.

A glass tube, eighteen inches long, and one inch in diameter, standing upright, its upper end closed, and its lower end, which was open, screwed into a brass pipe, through which the external water had a passage into the glass tube, served as a water-gage or barometer. There was a piece of cork, with phosphorus on it, put into the water-gage. When the vessel descended the water rose in the water-gage, condensing the air within, and bearing the cork, with its phosphorus, on its surface. By the light of the phosphorus, the ascent of the water in the gage was rendered visible, and the depth of the vessel under water ascertained by a graduated line.

An oar, formed upon the principle of the screw, was fixed in the fore part of the vessel; its axis entered the vessel, and being turned one way, rowed the vessel forward, but being turned the other way, rowed it backward; it was made to be turned by the hand or foot.

A rudder, hung to the hinder part of the vessel, commanded it with the greatest ease. The rudder was made very elastic, and might be used for rowing forward. Its tiller was within the vessel, at the operator's right hand, fixed at a right angle, on an iron rod, which passed through the side of the vessel; the rod had a crank on its outside end, which commanded the rudder, by means of a rod extending from the end of the crank to a kind of tiller, fixed upon the left hand of the rudder. Raising and depressing the first-mentioned tiller turned the rudder as the case required.

A compass, marked with phosphorus, directed the course, both above and under the water; and a line and lead founded the depth when necessary.

The internal shape of the vessel, in every possible section of it, verged toward an ellipsis, as near as the design would allow, but every horizontal section, although elliptical, yet as near to a circle as could be admitted. The body of the vessel was made exceedingly strong; and to strengthen it as much as possible, a firm piece of wood was framed, parallel to the conjugate diameter, to prevent the sides from yielding to the great pressure of the incumbent water in a deep immersion. This piece of wood was also a seat for the operator.

Every opening was well secured. The pumps had two sets of valves. The aperture at the bottom, for admitting water, was covered with a plate, perforated full of holes to receive the water, and prevent anything from choking the passage, or stopping the valve from shutting. The brass valve might likewise be forced into its place with a screw, if necessary. The air pipes had a kind of hollow sphere, fixed round the top of each, to secure the air pipe valves from injury; these hollow spheres were perforated full of holes, for the passage of the air through the pipes; within the air pipes were shutters to secure them, should any accident happen to the pipes, or the valves on their tops.

Wherever the external apparatus passed through the body of the vessel, the joints were round, and formed by brass pipes, which were driven into the wood of the vessel, the holes through the pipes were very exactly made, and the iron rods, which passed through them, were turned in a lathe to fit them; the joints were also kept full of oil, to prevent rust and leaking. Particular attention was given to bring every part necessary for performing the operations, both within and without the vessel, before the operator, and as conveniently as could be devised; so that everything might be found in the dark, except the water-gage and the compass, which were visible by the light of the phosphorus, and nothing required the operator to turn to the right hand, or to the left, to perform anything necessary.

THE MAGAZINE.

In the fore part of the brim of the crown of the submarine vessel was a socket, and an iron tube, passing through the socket; the tube stood upright, and could slide up and down in the socket, six inches; at the top of the tube was a wood screw, fixed by means of a rod, which passed through the tube, and screwed the wood screw fast upon the top of the tube; by pushing the wood screw up against the bottom of a ship, and turning it at the same time, it would enter the planks; driving would also answer the same purpose; when the wood screw was firmly fixed, it could be cast off by unscrewing the rod, which fastened it upon the top of the tube.

Behind the submarine vessel was a place above the rudder for carrying a large powder magazine; this was made of two pieces of oak timber, large enough, when hollowed out, to contain one hundred and fifty pounds of powder, with the apparatus used in firing it, and was secured in its place by a screw, turned by the operator. A strong piece of rope extended from the magazine to the wood screw above mentioned, and was fastened to both. When the wood screw was fixed, and to be cast off from its tube, the magazine was to be cast off likewise by unscrewing it, leaving it hanging to the wood screw; it was lighter than the water, that it might rise up against the object, to which the wood screw and itself were fastened.

Within the magazine was an apparatus, constructed to run any proposed length of time, under twelve hours; when it had run out its time, it unpinioned a strong lock resembling a gun lock, which gave fire to the powder. This apparatus was pinioned, that it could not possibly move, till, by casting off the magazine from the vessel, it was set in motion.

The skilful operator could swim so low on the surface of the water as to approach very near a ship in the night, without fear of being discovered, and might, if he chose, approach the stem or stern above water, with very little danger. He could sink very quickly, keep at any depth he pleased, and row a great distance in any direction he desired, without coming to the surface, and when he rose to the surface, he could soon obtain a fresh supply of air, when, if necessary, he might descend again and pursue his course.

EXPERIMENTS.

In the first essays with the submarine vessel I took care to prove its strength to sustain the great pressure of the incumbent water, when sunk deep, before I trusted any person to descend much below the surface; and I never suffered any person to go under water without having a strong piece of rigging made fast to it, until I found him well acquainted with the operations necessary for his safety. After that I made him descend, and continue at particular depths, without rising or sinking, row by the compass, approach a vessel, go under her, and fix the wood screw mentioned before into her bottom, etc., until I thought him sufficiently expert to put my design into execution.

I found, agreeably to my expectations, that it required many trials to make a person of common ingenuity a skilful operator; the first I employed was very ingenious, and made himself master of the business, but was taken sick in the campaign of 1776, at New York, before he had an opportunity to make use of his skill, and never recovered his health sufficiently afterward.

ATTEMPT TO SINK A BRITISH SHIP OF WAR.

After various attempts to find an operator to my wish, I sent one, who appeared more expert than the rest, from New York, to a fifty gun ship, lying not far from Governor's Island. He went under the ship, and attempted to fix the wooden screw into her bottom, but struck, as he supposes, a bar of iron, which passes from the rudder hinge, and is spiked under the ship's quarter. Had he moved a few inches, which he might have done, without rowing, I have no doubt but he would have found wood where he might have fixed the screw; or, if the ship were sheathed with copper, he might easily have pierced it; but not being well skilled in the management of the vessel, in attempting to move to another place, he lost the ship; after seeking her in vain, for some time, he rowed some distance, and rose to the surface of the water, but found daylight had advanced so far, that he durst not renew the attempt. He says that he could easily have fastened the magazine under the stern of the ship, above water, as he rowed up to the stern, and touched it before he descended. Had he fastened it there, the explosion of one hundred and fifty pounds of powder (the quantity contained in the magazine) must have been fatal to the ship. In his return from the ship to New York he passed near Governor's Island, and thought he was discovered by the enemy on the island; being in haste to avoid the danger he feared, he cast off the magazine, as he imagined it retarded him in the swell, which was very considerable. After the magazine had been cast off one hour, the time the internal apparatus was set to run, it blew up with great violence.

Afterward, there were two attempts made in the Hudson River, above the city, but they effected nothing. One of them was by the afore-mentioned person. In going toward the ship, he lost sight of her, and went a great distance beyond her; when he at length found her, the tide ran so strong, that, as he descended under water for the ship's bottom, it swept him away. Soon after this the enemy went up the river, and pursued the boat which had the submarine vessel on board, and sunk it with their shot. Though I afterward recovered the vessel, I found it impossible, at that time, to prosecute the design any farther. I had been in a bad state of health, from the beginning of my undertaking, and was now very unwell; the situation of public affairs was such, that I despaired of obtaining the public attention, and the assistance necessary. I was unable to support myself and the persons I must have employed, had I proceeded. Beside, I found it absolutely necessary that the operators should acquire more skill in the management of the vessel, before I could expect success; which would have taken up some time, and made no small additional expense. I therefore gave over the pursuit for that time, and waited for a more favorable opportunity, which never arrived.

Alabaster and Plaster of Paris.

Alabaster is a compact gypsum, and occurs massive, with a compact fracture; it is translucent; has a glimmering luster, and its colors are white, reddish, or yellowish.

The purest kinds of this mineral are used in Italy for vases, cups, candlesticks, and other ornaments. It is found at Castelino, in Tuscany, thirty-five miles from Leghorn, at two hundred feet below the surface of the earth.

The yellow variety, called by the Italians *alabastro agatato*, is found at Sienna; another variety of a bluish color, obtained at Guercieto, is remarkably beautiful, being marked with variegated shades of purple, blue, and red. These alabasters are carbonates of lime.

The principal manufactory of alabaster ornaments is at Valterra, thirty-six miles from Leghorn, where about five thousand persons live by this kind of labor. In making, they require great care, and must be preserved from dust, as the alabaster is difficult to clean. Talcum, commonly called French chalk, will remove dirt, but the best mode of restoring the color, is to bleach the alabaster on a grass plat. Gum water is the only cement for uniting broken parts.

Plaster of Paris is likewise a compact gypsum, but contains a small portion of carbonic acid, which makes it effervesce when treated with acids. It was formerly exported only from Montmartre, near Paris, hence its name; it is much used in ornamenting rooms in stucco, in taking impressions of medals, in casting statues, busts, vases, timepiece stands, candelabras, obelisks, and for many other purposes.

The common plaster of Paris is ground after being calcined; and in this condition it has the property of forming a pliable mass with water, which soon hardens, and assumes the consistency of stone.

Oriental alabaster is not a sulphate but a true carbonate of lime, and on account of its peculiar tint and transparency, and as it appears that it was formed similar to stalagmite, it was called by the ancients, alabaster.

M. KRUPP is about to construct, at his works at Essen, a single-acting steam hammer, far exceeding in size any now in existence. The design for this hammer—which will have a head weighing 120 tuns—have already been prepared, and the patterns are now in hand. At present, the largest hammer at M. Krupp's enormous establishment is one with a 50-tun head, falling nine feet, six inches. This is a single-acting hammer—the only one on the works, all the others being double-acting. The smaller hammers have heads varying from twenty-five tuns downwards. In addition to these, M. Krupp has also some peculiar tilt-hammers, in which a steam cylinder is placed between the head and fulcrum of the hammer, and the piston working in this cylinder is directly coupled to the hammer shaft by a connecting rod.

The Wondrous Textile Fabrics of Hindoostan.

In the manufacture of muslin the Hindoos surpass all other people, as they do in the manufacture of the Cashmere shawl. There is a class of muslin termed "woven air," the fabric of which is so marvelously fine that the Hindoos themselves are fond of relating all kinds of strange theories respecting it.

Mr. Bolt, in his "Consideration of the Affairs of India," speaking of the Dacca muslins, says that according to report, the Emperor Aurungzebee once "was angry with his daughter for showing her skin through her clothes, whereupon the young princess remonstrated in her justification, that she had seven *japîthz*, or suits, on; another tale was to the effect that, "in the Nabob Allaverdy Kahwan's time, a weaver was chastised and turned out of the city of Dacca for his neglect in not preventing his cow from eating up a piece of "Abrovan," which he had spread and left upon the grass—the muslin, of course, being so fine that the animal could not see it upon the herbage.

So delicate is the manufacture of the short staple of the Dacca cotton, that it can only be woven into yarn at certain times of the day. The morning is generally so employed before the dew has left the grass; if spinning is carried on after that time, the spinner, who is always a woman under thirty years of age, spins the yarn over a pan of water, the evaporation of which affords sufficient moisture to prevent the fibers from becoming too brittle to handle. Delicate as the muslin is, it will wash, which European muslins will not. The durability of the Dacca muslin, notwithstanding its surprising fineness—a piece of "evening dew" one yard wide and four yards long, only weighing 556 grains—is said to be owing to the greater number of twists given to the Dacca yarn, as compared with the finest muslin yarns of England or France. The time taken to spin and weave the threads in a piece of "woven air" is very great; the reader will not therefore be surprised to hear that it sells at the rate of a guinea a yard.

The "Abrovan," or "Running Water," is considered the second class of muslin; "Sabaum," or "Evening Dew," is the third quality. It is so called because it is so fine that it can scarcely be distinguished from dew upon the grass. There are several other very fine Dacca muslins that are known by distinctive names, but these so poetically designated are the most famous. The Daghdhobees, who remove iron mold from this precious material, use the juice of the amroold plant for that purpose; and to remove other spots or stains a composition of ghel, lime, and mineral alkali. There are Mahommedans who also repair this "woven air" with a skill equal to that of the Hindoo, who weaves it. For instance, it is said that an expert Rafuger, or darner, "can extract a thread twenty yards long from a piece of the finest muslin of the same dimensions, and replace it with one of the finest quality." It is said that they execute their finest work under the influence of opium.

A still more exquisite and expensive work of the Indian loom is the figured muslin. A piece of this fabric measuring twenty yards, made in 1776, cost as much as £56. The splendid yet subdued effect of weaving gold and silver thread into the different fabrics made in India has never even been approached by Europeans. Some of their silks have a sheen upon them like the breast of a pigeon, or indeed of the Impeyan pheasant. In nature we never find that even the most splendid effects offend the eye by appearing harsh. The Indian artist seems to have caught the very art there is in nature, and he uses his gold and silver with a caution, a prodigality, and an economy fitted for the occasion. The native never throws away gold where it will not be seen. Thus on the turban cloth only the end that hangs down by the neck is thus ornamented; in the waistcloth the fringed end, etc. The gold thread is so very pure that it never tarnishes, and it washes just as well as the other threads of the garment. The thread of the precious metals is called kullabutoon, and is manufactured wholly by hand.

The embroidery in the woven garments in which this absolutely pure gold is employed never tarnishes—a perfection to which European fabricators have not yet attained.

[We have seen a vail brought by Gov. Thomas H. Seymour—who was for six years our Minister to St. Petersburg—from Tartary, which, although one yard wide and three long, would float in the atmosphere for an appreciable time before descending to the floor.—EDS.

The Limits of the Human Ear.

Prof. Tyndall, in a course of lectures on "Sound," delivered before the Royal Institution of Great Britain, states that the perception by the ear of musical sounds and the range of hearing in general is limited by quite narrow bounds.

Savart fixed the lower limit of the human ear at eight complete vibrations a second; and to cause these slowly recurring vibrations to link themselves together, he was obliged to employ shocks of great power. By means of a toothed wheel and an associated counter, he fixed the upper limit of hearing at 24,000 vibrations a second. Helmholtz has recently fixed the lower limit at 16 vibrations, and the higher at 38,000 vibrations, a second. By employing very small tuning-forks, the late M. Depretz showed that a sound corresponding to 38,000 vibrations a second is audible. Taking the limits assigned by Helmholtz, the entire range of the human ear embraces about 11 octaves. But all the notes comprised within these limits cannot be employed in music. The practical range of musical sounds is comprised between 40 and 4,000 vibrations a second, which amounts, in round numbers, to 7 octaves. "The deepest tone of orchestra instruments is the E of the double bass, with $41\frac{1}{4}$ vibrations. The new pianos and organs go generally as far as C^{1} with 33 vibrations; new grand pianos may reach A^{11} with with $27\frac{1}{2}$ vibrations. In large organs a lower octave is introduced reaching to C^{11} with $16\frac{1}{2}$ vibrations. But the musical character of all these tones under E is imperfect, because they are near the limit where the power of the ear to unite the vibrations to a tone ceases. In highth the pianoforte reaches to a^{iv} with 3,520 vibrations, or sometimes to c^{v} with 4,224 vibrations. The highest note of the orchestra is probably the d^{v} of the piccolo flute, with 4,752 vibrations."

Rule of the Road for Steamers.

The following lines seem to be admirably adapted for the purpose of preventing collisions at sea. They are calculated to imprint upon the minds of mariners the "Rules of the Road for Steamers," more vividly and indelibly than any other process would effect. The author will achieve as great an amount of fame as he who paraphrased the days of the months, and the number of days in each :—

1. Two steamships meeting end on, or nearly end on.

Meeting steamers do not dread
When you see three lights ahead!
Port your helm, and show your Red.

2. Two steamships passing.

For steamers passing, you should try
To keep this maxim in your eye:—
Green to Green—or, Red to Red—
Perfect safety—go ahead!

3. Two steamships crossing. This is the real position of danger. The steamship that has the other on her own starboard side shall keep out of the way of the other. There is nothing for it but good look-out, caution, and judgment.

If to starboard Red appear,
'Tis your duty to keep clear;
Act as judgment says is proper:—
Port—or starboard—back—or, stop her!

But when on your Port is seen
A steamer with a light of Green,
There's not so much for you to do,
The Green light must keep clear of you.

4. All ships must keep a good look-out, and steamships must stop and go astern, if necessary.

Both in safety and in doubt
Always keep a good look-out;
Should there not be room to turn,
Stop your ship, and go astern.

—*Mechanics' Magazine.*

Subjugating an Elephant.

Recently, a Cincinnati paper says, a circus elephant, thirty-six years old, 10,000 pounds weight, and named Tippoo Saib, while in winter quarters at Connorsville, Indiana, became unruly on account of a change of his keeper, and went to war against all mankind. He would allow no one in his quarters, and struck at every one who approached him with his trunk and tusks most violently. His keeper determined to subdue him, and the process and result are thus described: The new keeper, with nine assistants, had fully equipped himself with chains and cables for tying, and spears and pitchforks for subduing Tippoo. The first thing done was to fasten a brick-bat to the end of a rope and throw it over the end of the tusk-chain, which latter is fastened to one leg and one tusk. By means of this rope a 20-tun cable chain (formerly used to subdue the famous Hannibal) was slip-noosed around the tusk. Next, an excavation three feet deep was made under the sill of the house, and while the elephant's attention was attracted to the other side of the room by a pail of water poured into his trough, the cable chain was passed through the excavation and fastened to heavy stakes outside. All this time the infuriated monster struck all around him with terrible ferocity, and tugged at his chain with incredible momentum. The next thing accomplished was the snaring of his hind legs. This was consummated by the slinging of fresh ropes around those two stately pillars of elephant flesh, bone and muscle, and finally, by the stealthy strategy of the keeper and another man, these ropes were fastened to stumps outside. The elephant was now sufficiently pinioned to allow the order, "Charge pitchforks," to be given. Ten men, armed with these ugly implements of offense, plunged them into the rampaging beast, taking care, of course, to avoid penetrating his eyes or joints. The tenderest spot in an elephant is just behind the fore legs, and that locality was prodded unmercifully. By means of a hooked spear sunk in his back, Tippoo was brought to his knees, but he surged up again with such awful strength that he swept his tormentors off their feet and made his chains whistle like fiddle-strings. After an hour's fighting he was brought down on his side, but for two hours longer he tugged at his chains with frenzied obstinacy. He pulled so hard at times that his hind legs were straight out behind him, and three feet off the ground. At the end of three hours the giant gave in by trumpeting, which is the elephant's way of crying enough. The moment this peculiar cry was heard the battle ceased. The keeper made Tippoo get up and lie down a number of times, and he was as obedient to the word of command as a gentle pony. The animal was then groomed and rubbed off with whisky. He allowed all manner of liberties without so much as flapping an ear. He was a subjugated elephant.

Scotland's Pebbles.

Scotland can boast of her pebbles and fine specimens of quartz found in the form of perfect crystals, varying in color from pure white to amber and a deep brown. Our native pebbles are of singular conformations, and are of all colors—red, green, grey, auburn, yellow, and also of the jasper kind with a mixture of colors. A curious phenomenon connected with the color of pebbles is, that each color is found only in distinct localities.

Pebbles are found in every county of Scotland, but more plentifully in Ayrshire, Argyleshire, Aberdeenshire, Perthshire, Morayshire, Roxburghshire and Mid Lothian. There is the Arthur Seat jasper, found on Arthur's Seat; the Pentland pebble on the Pentland Hills; the Perth bloodstone on the Ochil and Moncrieff Hills; the Montrose grey pebble at Montrose, and so on. A small rivulet in the land of Burns contributes one of the richest and finest specimens that is to be found in Scotland. The Arthur Seat jasper deserves special notice, being rich in color and variegated in streaks. It is found in large quantities on the face of the hill. On the top of the Cairngorm ranges, in Aberdeenshire, the cairngorm stones or crystals are found in great abundance. Not many years ago the Scotch amethyst could be plentifully procured and cheaply purchased, but now it is becoming scarce, and brings in the market from 50s. to 60s. per ounce. Another favorite Scotch crystal is the garnet. It has a red. or port wine color, and is found in very small quantities, of no great size, at Elie Point and along the sands on the coast of Fife. A jewel in which the yellow cairngorm, the lilac amethyst, and the pink or red garnet is harmoniously combined, is remarkably fine. Our moss agate is not the least beautiful and valuable of gems, and for certain styles of setting it is peculiarly suitable. But the chief of our Scottish gems is the pearl. There was a tiara finely set in gold and enamel in the Dublin Exhibition, valued at £500, made of Scotch pearl. Fine specimens of pearls are found in the rivers Forth, Teviot, Clyde, Earn, Tay, Tweed, and the rivers of Ross and Sutherlandshires. A fine specimen not larger than a pea will bring £25, and large ones will command at times as much as £80 or £90.—*London Mining Journal.*

South American Coal Mines.

Coal exists at various localities along the Pacific coast, from Russian America to Patagonia, and is now mined to a limited extent in Vancouver's Island, Washington Territory, Oregon, California, at Panama, in New Granada, and at the towns of Lota, Lotilla, and Coronel, in Chili. But all these coals are of later date than the true Carboniferous, and appear to be the production of periods from the Jurassic to the Tertiary. They are of all grades of the bituminous class, from the mineral pitch, or asphaltum, to the natural coke. The veins or seams are generally thin and unreliable, and subject to the imperfections natural to all coals of recent formations. But, under present circumstances, these deposits of coal are invaluable to the commerce of the Pacific.

The coal mines of Panama are worked by several English and American companies, almost exclusively for the use of the ocean steamers of the Pacific. The coal is of a soft, bituminous character, and is much inferior to the English and our Cumberland steam coals.

Though coal exists at intervals along the entire Pacific coast, it is only worked at two prominent points south of California, viz., Panama and at the Chilian mines in the northern portion of Araucania. The mines in Chili are located at the towns or bays of Lota, Lotilla, and Coronel, which lie about 200 miles north of Valdivia. The coal area is comparatively extensive, but the seams are generally thin and frequently terminate abruptly. Their dip is irregular or undulating, and mining operations are conducted by both shaft and drift. A considerable coal trade is done here, and sailing vessels are constantly being laden for various ports on the Pacific, and passing steamers generally supply themselves here. The coal is soft, and burns rapidly with great flame and smoke, but leaves only a moderate residuum, and makes no clinker.

Electrical Countries.

In a paper addressed to the Academy of Sciences, M. J. Fournet treats of a new and curious subject, viz., the electric state of certain regions. From the report of this paper, in "Galignani," it appears that in the mountains of the basin of the Rhone and their offshoots, there are some spots distinguished for their evolution of electricity, which is sometimes very remarkable; while others, though apparently identical in surface, are in a state of absolute electric neutrality. Some very striking instances of this are quoted by M. Fournet. On the night of August 11, 1854, when Mr. Blackwell was on the Grands-Mulets, at an altitude of 3,455 meters, the guide, F. Couttet, on leaving the hut, perceived the surrounding ridges apparently on fire. He immediately called to his companion to witness the scene, which was owing to a tempest. Their clothes were literally covered with electric sparks, and their fingers, when held up, were phosphorescent. At that very time Lyons was visited with a deluge of rain, and the whole day had been exceedingly stormy. In 1841, as the same guide was accompanying M. Chenal up Mont Blanc, they were overtaken by a violent storm, and found themselves enveloped, as it were, in thunder and lightning. All the stones and rocks around them emitted electric flames, and yet the summit of Mont Blanc, and the sky around it, was perfectly clear. In 1867, Saussure, Jalabert, and Pictet, were on the Breven at an altitude of 2,520 meters. They soon experienced a strange pricking sensation at their fingers' ends on stretching them out. This sensation became stronger and stronger, and at length electric sparks could be drawn from Jalabert's hat-band, which was of gold lace, and even from the knob of his cane. As the storm was raging above their heads, they had to descend some twenty-five or thirty meters, where the influence of this electricity was no longer felt. Another instance of this occurred on July 10, 1863, when Mr. Weston and several other tourists ascended the Jungfrau, and there the snow itself, which fell during the storm which overtook them, proved to be electric.

WE see by a cable despatch that Brown & Level's life-saving tackle, for instantaneously lowering and detaching small boats from the sides of vessels going at full speed, has been adopted by the French navy, after a trial at Toulon. We are pleased to hear of Messrs. Brown & Level's success in introducing their most excellent invention abroad. Patents upon it were secured through this office in the United States, England, and in several countries on the continent.

Bullock's Printing Machinery.

The largest proportion of all the letter-press printing now done, is executed upon what are known as "cylinder" printing machines—a discovery which dates back to 1790, due, we believe, to William Nicholson, of England, who, about that period, took out a patent. His plan consisted in attaching the types to a cylinder, and the impression was produced by making the types press against the sheet, which was carried on another cylinder. This is the general principle upon which all of the fastest newspaper presses now operate. A modified form of cylinder press, in which the types are placed on a flat bed, while the sheet is carried on a cylinder, is very extensively employed for book and job printing.

In nearly all of the above forms of cylinder presses the paper is only printed upon one side, and is fed to the machine by hand one sheet at a time. The operation is thus partly mechanical and partly manual After the edition has been all passed through and printed upon one side, the types are changed and the second side is printed. For every printing cylinder an attendant or "feeder," as he is termed, is required. If the press has one cylinder, then one "feeder" works; if two cylinders, then two feeders.

On page 136, current volume, the reader will find an illustration of the great ten-cylinder printing presses now in use at the *New York Herald* office. It is the practice at the *Herald, Tribune, Times*, and other prominent daily newspaper offices, to run two or more of these great printing presses, and to transfer the sheets from one press, as fast as one side is printed, to the other press, thus quickly completing the presswork on both sides. To run two of these presses requires the employment of twenty men as "feeders." Their wages are about $3 a day each, so that the cost of merely placing the sheets on the press forms a great item of newspaper expense.

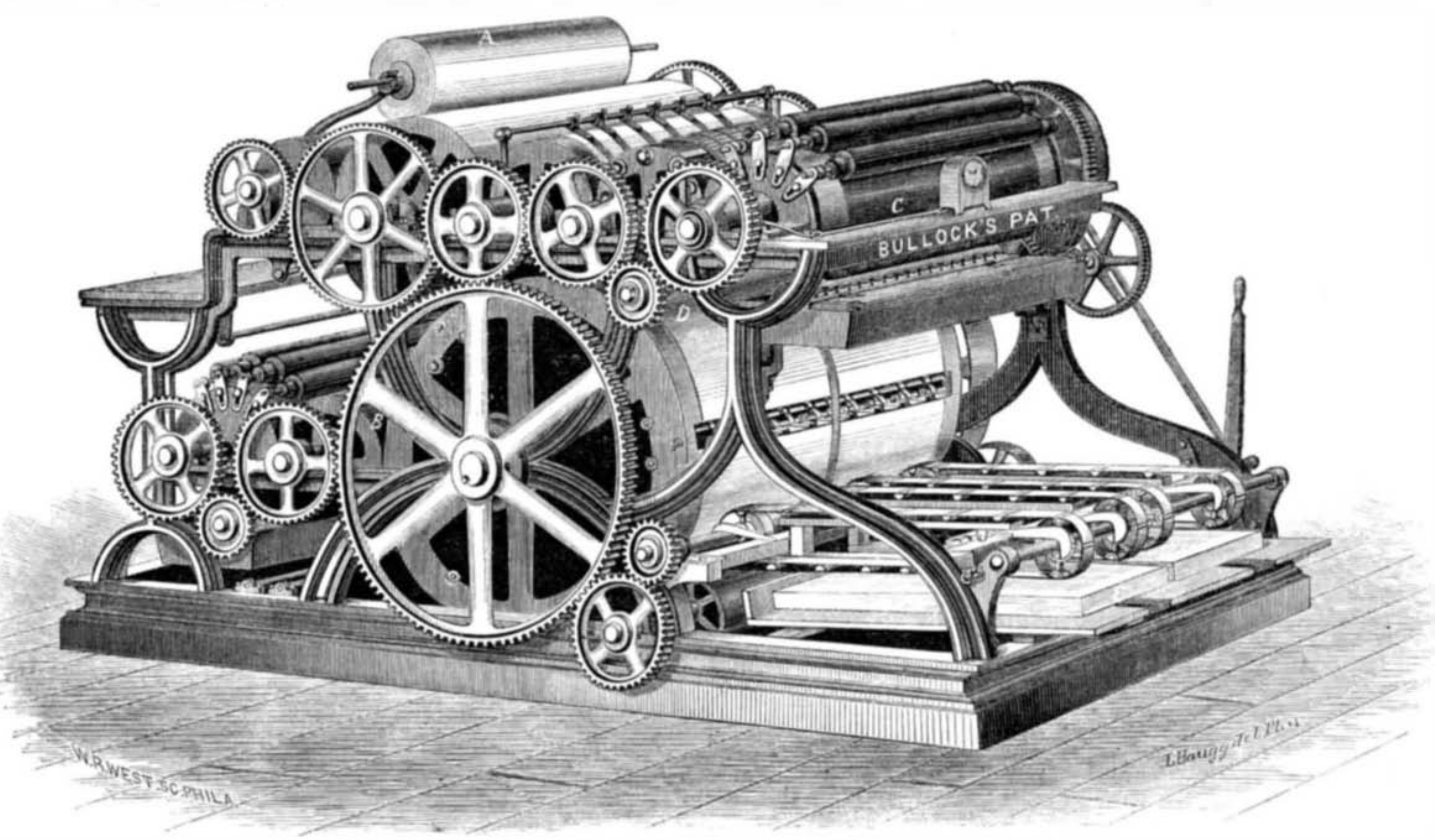
Many attempts have been made to get rid of this expense by rendering the cylinder presses automatic in their operation, but without much success until the rare genius of the late William Bullock, of Pennsylvania, developed new light upon the subject. In carrying out his plans he made practical use of the important and valuable patents of Mr. M. S. Beach, the present proprietor of the *New York Sun*. We have the pleasure to present herewith several illustrations of Mr. Bullock's inventions.

In his Self-feeding and Perfecting Machine the paper is supplied to the press in the form of a large roll, A, containing enough to make several thousands of newpapers. B are the type cylinders, on which the usual stereotype plates are secured; C are the inking cylinders; D the blanket cylinders, between which and the type cylinders the sheets are pressed and printed.

The operation is very simple. The roll of paper, A, having been mounted in its place, the machinery is started, unwinds the paper, cuts off the required size, prints it on both sides at one operation, counts the number of sheets and deposits them on the delivery board, E, at the rate of 8,000 to 14,000 per hour, or counting both sides, at the rate of 16,000 to 28,000 impressions, The labor is only that of placing the rolls on the press and removing the printed paper, which ordinary hands can do.

We have seen some most excellent book printing done on the Bullock machines which are at work in the government offices in Washington. They are also employed in some of the prominent newspaper offices in Philadelphia and New York. At the *Sun* office, in this city, the Bullock presses have been in use for a long time in turning out the immense daily edition of that paper. Two more presses—the same kind but of an enlarged and superior pattern—are now being introduced there.

The Bullock press promises to effect a considerable revolution in the art of printing. It is adapted to all kinds of presswork, fine or rapid. Its capacity for the rapid production of printed sheets is unequalled. Its first cost is comparatively small. But a small place or room is necessary for setting it up. The largest size is eleven feet long, six feet wide, and six feet high. Only two hands, common laborers, exclusive of pressmen, are required for its management. Being simple in construction it is not liable to get out of order and can be easily repaired.

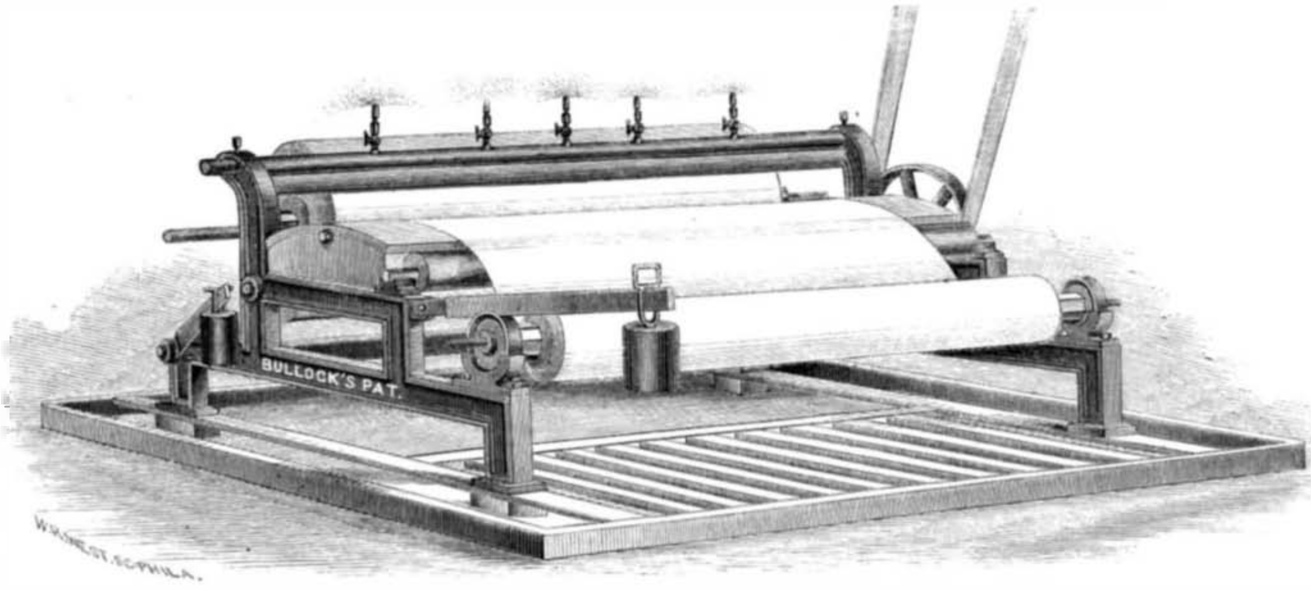


BULLOCK'S SELF-FEEDING AND PERFECTING PRESS.

We have seen an official report, by O. H. Reed, superintendent of the press room in the government printing office at Washington, made to John D. Defrees. Congressional Printer, in which he shows that it would require eighteen of the Adams presses to do the same amount of book-work now being executed on a single Bullock press; and that the use of this press effects a net economy of $375 a week over such Adams presses. The Bullock press prints 200,000 octavo pages in a single hour. It runs with great steadiness and uniformity, and the number of spoiled impressions average only about one-tenth of one per cent. The estimated average of spoiled sheets on the common fast newspaper presses is between one and two per cent. The ordinary presses require of the paper manufacturer that before delivery he shall cut his goods into sheets, count, wrap and tie them up in separate bundles. All this consumes much wrapping paper, twine and time, which is saved by the use of the Bullock press, as the paper is delivered in rolls just as it naturally issues from the paper-making machine, and the paper-maker is enabled to supply paper for these improved presses at from one to two cents a pound cheaper than ordinary paper. The Bullock press prints with a perfect register, and for newspaper work this is important as it permits the reduction of the blank margin of the sheet, and thus saves paper.

Altogether the advantages and economies in favor of these new machines are so great that, in many cases, printers might, by adopting them, be enabled to throw away their present cumbersome presses as old iron, and make a very large annual profit by the operation. Think of saving $5,000 on the presswork of a single job. This is the statement from the government office in reference to the printing of the volume of the Agricultural Report which was printed on a Bullock press.

In connection with the printing machine Mr. Bullock invented a very simple and excellent device for wetting the roll of paper, which we also illustrate. It will be readily understood by a glance at the engraving. The paper is passed from one roller to another, and midway in its passage a number of jet fountains are so arranged that their spray will fall upon the passing sheet.

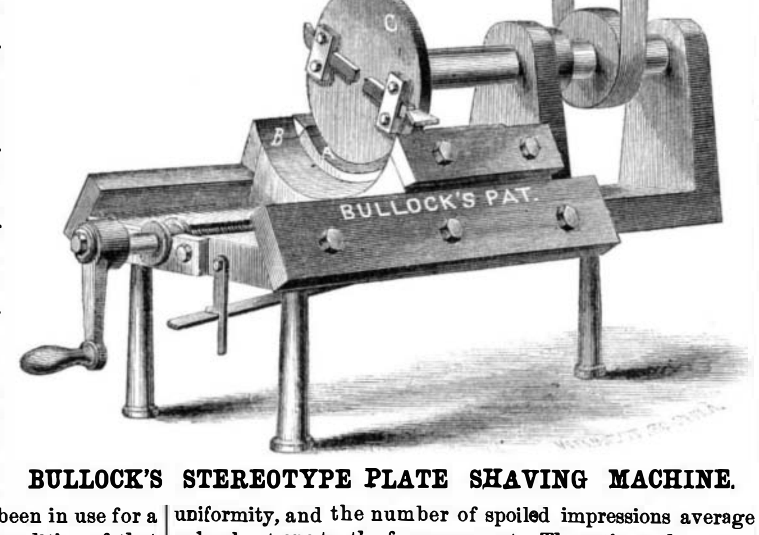


BULLOCK'S PAPER WETTING MACHINE.

Another very ingenious improvement is the machine for shaving the backs of the curved stereotyped plates. The plate, A, rests in the concave movable bed, B, which travels under the cutter head, C. The latter rotates with great rapidity, and reduces the back of the entire plate to a perfect parallel with the type face in the short space of two minutes.

Full information concerning these valuable inventions can be obtained by addressing the Bullock Printing Press Company, 738 Sansom street, Philadelphia.

The Company manufacture several modified forms of presses, for printing both sides, suitable for small editions of books and newspapers.



BULLOCK'S STEREOTYPE PLATE SHAVING MACHINE.

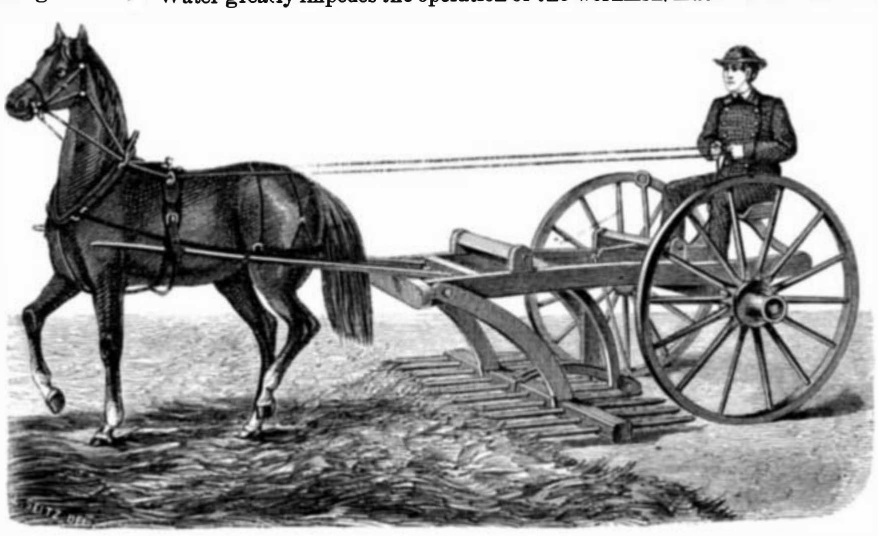
IN France milk is packed in small tins, easily moved by one man, and by a simple contrivance the stopper screws close down upon the contents of each tin, so that the motion of the railway cannot churn the milk *in transitu*. The tins are then placed in covered wagons, and in summer are wrapped in cloths, which are watered from time to time, so as to promote coolness by evaporation. The result of this care, which costs but little, is that the milk supply of Paris is proverbially excellent. Why do not some of our New York milk dealers adopt this plan?

THE MILLIONTH PART OF AN INCH.—Mr. Whitworth has been striving to give to a committee from the House of Lords a just conception of this extremely minute subdivision of a linear space. He uses this illustration: "You have only to rub a piece of soft steel a few times to diminish its thickness a millionth of an inch.

Self-Adjustable Single-Horse Hay Rake.

One of the principal obstacles to the general adoption of the horse hay rake in some portions of the country, where the land lies in alternate hill and dale or hole and knoll, is the continual care and anxiety on the part of the driver to avoid the sudden inequalities of the ground and still gather his hay in a workmanlike manner. It is enough to do to keep the horse or horses in train without being compelled to attend also to every obstacle in the form of irregularities on the surface of the ground.

The engraving presents a perspective view of a single horse hay rake, the teeth of which are allowed to adapt themselves automatically to the surface of the ground without the direct intervention of the driver. The rake head is suspended by braces projecting downward from the front of the curved side bars, the connections being made with straps passing from the braces around bearings on the rake head. The teeth are held in position by similar curved arms which reach to the rear side of the teeth and are held by notches on the teeth. A pawl engages with two projections on the rake head, which is pivoted to the rear curved arms and is operated by a handle directly in front of the driver's seat. When the rake is loaded the driver merely pulls this handle toward him, which disengages the pawl, when the rake revolves and discharges the load, the pawl at once reëngaging with the rake head and holding it in position for gathering another load, the teeth of the rake, by the peculiarity of its suspension, allowing sufficient movement for ready adaptation to the unevenness of surface and still keeping close to the ground.



JOHNSON'S IMPROVED HAY RAKE.

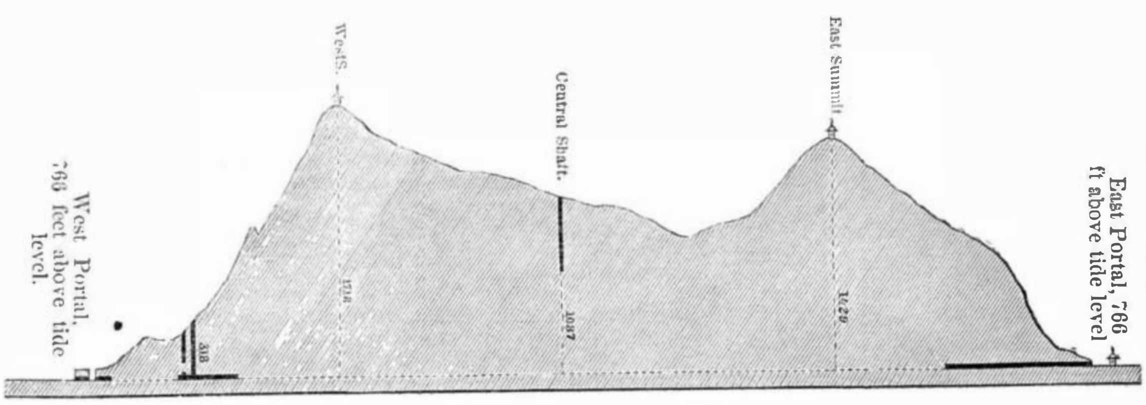
The rake cannot be thrown out of gear or revolved by this slight movement until the driver releases it from contact with the pawl, which is entirely under his control. No more definite description is probably necessary for a proper understanding of the peculiarities and advantages of the implement.

It is the subject already of several Fair premiums, although the letters patent—secured through the Scientific American Patent Agency—are dated only July 2d, 1867. Rights are for sale by the inventor, Sylvester Johnson, box 238, Evansville, Ind.

The Great American Tunnel through the Hoosac Mountain.

We reproduce a profile view of the Hoosac mountain and tunnel, from the official report of the Joint Standing Committee of the Massachusetts Legislature on the Troy and Greenfield Railroad, because great general interest has been felt in its progress, which the terrible accident of Oct. 19th has revived and stimulated.

The charter of the road known as the "Troy and Greenfield Railroad" was granted in 1848, and it authorized the construction of a railroad from a point on the "Vermont and Massachusetts Railroad," at or near Greenfield, Mass., to the line of the States of New York or Vermont, to connect with any railroad which might be constructed from or near Troy, N. Y. Its capital stock was limited to $3,500,000. The great work to be done was to construct a tunnel under the Hoosac mountain, a distance of nearly five miles, of which, on the first of January last, 5,873 feet had been bored.



THE HOOSAC TUNNEL.

The progress of the work has been greatly retarded by the inability of contractors to perform their engagements, owing partially to the errors made in calculating for the work—such calculations being more or less, from the nature of the undertaking, conjectural—and from financial difficulties. On the first of January, 1867, the excavations at the east end had reached the extent of 569 feet, at the rate of about 47.42 feet per month. But little has been done at the west end. The tunnel here must, from the nature of the strata, be sided and arched with brick, for the manufacture of which extensive brick yards have been established in close proximity. 24,000 bricks are molded daily by six brick machines.

The dimensions of the tunnel are as follows: Rock cutting, 24 feet high and 24 feet wide; the brick work, 26 feet high and 26 feet wide; the bottom of the tunnel having a culvert three feet deep, the tunnel being graded toward either end to facilitate the escape and discharge of water. In the culvert is laid a 12-inch pipe for the conveyance of air for ventilating purposes; an 8-inch pipe to carry air for the drilling machines, and a 3-inch pipe for supplying water to the holes which are being drilled. If gas is to be used for lighting purposes, it will be conveyed in a similar manner.

At the east end are two air compressors, designed to drive the drills, each having four cylinders, those of one being 13 inches diameter by 20 inches stroke, and those of the other 25 inches diameter by 24 inches stroke. They are driven by water from a canal fed by the Deerfield river, a dam across which, being a part of the work, cost $244,912.29. The central shaft is intended to afford additional means of prosecuting the work of tunneling, and also to ventilate the tunnel when completed. It is of oval form, or its cross section is an ellipse whose axes are 27 and 15 feet respectively. When completed, its depth will be 1,037 feet. More than half that distance was completed when the terrible accident occurred which sent thirteen poor fellows into eternity. As the machinery for pumping the water from the shaft was destroyed by the fire it is rapidly filling up, and work is, of course, suspended here for a time.

The west shaft has an area of 8 by 13 feet, and is 316 feet deep. The power used here is an engine of 100, and one of 40 horse power, driving a compressor of four cylinders 13 inches diameter and 24 inches stroke. On the 1st of December last the heading toward the east was advanced 1,042 feet, and that toward the west, 293 feet.

Water greatly impedes the operation of the workmen, much of the power used being employed to free the tunnel and shafts. On one occasion, at the west shaft, the workmen struck a stream which discharged at the rate of 23 gallons per minute. The pumps were unable to prevent its rise, and larger ones had to be procured. After it was pumped out, on recommencing work, another vein was struck that discharged over 100 gallons per minute. Subsequently, and after extra exertions, the water was removed sufficiently to allow the work to proceed.

The new shaft is located about 264 feet westerly of the west shaft. It is 6 by 13 feet in diameter, and will be, when completed, 277 feet deep. It is worked from both above and below. On the first of January last, those working from the top had reached a depth of 180 feet, and those from below had progressed 45 feet. At this point are two engines, one of 14 and one of 10 horse power.

After making a succession of experiments with different drilling machines, the one known as the Burleigh drill has been finally adopted. We can give no intelligible description of it without diagrams. Much, however, of the work is done by hand drilling. For blasting, Dr. Ehrhardt's powder was tried in November, 1866, but its effect was not satisfactory, a poisonous gas being evolved which drove the miners from their work. The cost of this powder is about twice that of common powder but its power for blasting purposes is superior.

Last summer, Col. Tal. P. Shaffner experimented with nitroglycerin, an account of which we gave, from the pen of Col. Shaffner, at the time. The committee from whose report we quote speak highly of its effects, and recommend it as possessing palpable advantages. The blasting is done, however, with ordinary blasting powder, these attempts to supersede its use being evidently regarded merely as experiments. The blasts are fired entirely by electricity.

From the foregoing it will be seen that this great work is "making haste slowly." A glance at the diagram, which is drawn to a scale of little over 4,000 feet to the inch horizontal, and about 1,100 vertical, will show that with the methods hitherto employed it is almost hopeless to look for the completion of this work during the present generation. Meantime, however, some more rapid method of boring and mining may be introduced which may make what seems at present a task of almost infinite labor, one comparatively easy of successful accomplishment. We sincerely hope such may be the case.

Ancient Roman Draining Wheel.

The Paris *Presse* relates the discovery, in one of the mines of Portugal, of an old wheel which was doubtless employed by the Romans to raise water in the operation of draining the mine. It is well known that the hydraulic works of the Romans surpassed in extent any of those of modern times. As that great people had not the use of either steel or gunpowder, they were sometimes obliged to raise water over a ledge, where modern engineers would carry it right through. In some of the mines of San Domingo were dug draining galleries nearly three miles in length, but in some places the water was raised by wheels to carry it over the rocks that crossed the drift. Eight of these wheels have recently been discovered by the miners, who are now working the same old mines. These wheels are made of wood, the arms and felleys of pine, and the axle and its supports of oak, the fabric being remarkable for the lightness of its construction. It is supposed that these wheels cannot be less than one thousand and four hundred years old, and the wood is in a perfect state of preservation, owing to its immersion in water charged with the salts of copper and iron. From their position and construction these wheels are presumed to have been worked as treadmills by men standing with naked feet upon one side. The water was raised by one wheel into a basin, from which it was elevated another stage by the second wheel, and so on for eight stages. The wheel is on exhibition at the Academy of Arts

The Siemens Process.

Although the new mode of steel manufacture recently patented by Mr. C. W. Siemens has not as yet obtained a commercial standing or importance, it is attracting considerable attention on the part of metallurgists in this country and abroad. The Siemens process consists in reducing the iron from its ores by the action of gases containing a surplus of carbon, and elevated to a high temperature by the combustion of a part of these gases. It is, in fact, the action of a reductive flame, such as used very frequently in metallurgic operations on a large scale, or such as can be produced on a small scale by means of the blowpipe. This flame deprives the metal of the oxygen and other elements combined with it in the ore, and brings it down in a molten state, as cast iron if charged sufficiently with carbon and tapped at a low temperature, or as steel if the proportion of carbon be smaller, and the temperature of the furnace sufficiently high for keeping this steel in a liquid state. The process in its abstract and theoretical *rationale* is one of great scientific beauty. It attempts to treat with the materials in the most direct manner, avoiding all the different makeshifts and imperfections which are included in the present practice of iron smelting. In its practical development, the Siemens process has not as yet passed its infancy. Experiments have been made by Mr. Siemens in his model steel works at Birmingham apparently on a very small scale, and a small piece of steel made by his process is exhibited at Paris. The Barrow Steel Works have commenced experimenting on a much larger scale, a furnace which, according to present notions, may be considered a full-size specimen for practical work, having been erected in these steel works, and some charges of hematite ore having been smelted or reduced into steel in this furnace. Some ingots are said to have been produced, but the facts relating to the manner of working, and the lessons drawn from these first experiments, cannot be published yet. The furnace, we understand, is now about to be altered, and further experiments will be made with it shortly. At the recent visit of the guests of the Furness Railway Company to the Barrow Steel Works, this new furnace, although not in operation, and so far under reconstruction that very little of its internal arrangement remained visible, seemed to be regarded as an object of great interest by several visitors.

The question naturally arises, what are the practical advantages to be expected from this new process? but this cannot be answered otherwise than in very general terms at this early date. It is likely that the production of steel by the Siemens process will require less carbon than the present mode of first over-carburizing the iron, and then decarburizing it by a special and second process. It is also clear that the application of gaseous fuel will make the quality of iron much less dependent upon the quality of the fuel, since the very worst kinds of fuel can be made suitable for smelting by generating gases, and purifying the latter before they come in contact with the ore. The formation of a suitable slag in the process of smelting will, in an equal degree, lose its importance, since the iron in the Siemens furnace does not require a similar protection against any oxidizing influence, as is the case in the blast furnace in front of the tweers. The only condition which seems to come out more prominently and more forcibly in the Siemens process than in the present practice of iron smelting and steel making is purity of the ore. This, however, seems to become more and more a primary condition with iron smelting in its present form, and will not, by itself, interfere with the prospects of success of the new process, if all the other necessary conditions will be fulfilled in a sufficiently practical manner.—*Engineering.*

AN ACCURATE AIM.—After some experiments with the old musket in 1838, the committee of officers drew up a table of "instructions for soldiers" in firing with it. Among other things the soldiers are told, "in firing at a man at 600 yards, always aim 130 *feet above him.*" A note in *The Engineer* is our authority.

Steel Under the Microscope.

An experienced steel maker can estimate very closely the precise quality, chemical composition, tensile and compressive strength, and even the mode of treatment which a steel has undergone, by looking at its fracture. The appearance of the crystalline texture which is more or less discernable by the naked eye, and the method in which the reflected light gives certain variations of luster, are the scanty yet very important indications from which, by a series of guesses as to probabilities, an opinion may be formed which has every chance of being correct. This being the case, it seems very obvious that, by the assistance of the microscope, we should be capable of observing the texture of steel and iron fractures more correctly and more minutely, and a smaller amount of experience or nicety of observation should be sufficient—should enable us to form a correct opinion of the qualities of any given sample of steel. This is the case, and to such an extent that it is most astonishing how metallurgists could have neglected the use of the microscope to such an extent as it generally has been. We have already drawn attention in this journal to the interesting researches made by M. Schott, the manager of Count Stöllberg's foundery at Ilsenburg, upon the appearance of liquid and solidifying cast iron under the microscope, and we can quote the experience of this metallurgist as to the advantages to be obtained from microscopic observation of various kinds of steel. M. Schott, at his visit to the Paris Exhibition, made some most remarkable "guesses," as some steel-makers would call his conclusions, with regard to the qualities and method of manufacture of many hundreds of steel samples exhibited there, and of which he, in many cases, had no other knowledge than that which he could gather through the aid of a small pocket microscope, made of two pieces of rock crystal, formed into a very powerful single lens. A pocket microscope of this kind ought to be the companion of every man interested in steel manufacture. Lenses of the usual kind, even if piled up in sets of three or four, are entirely insufficient. The lens must be of a very small focus, and properly achromatic. A little practice is sufficient to enable the user to "see" through this lens; but it is, of course, not quite so easy to learn the meaning of what is thus seen, and to estimate from the appearance the quality of the steel inspected.

M. Schott has established for himself a kind of theory which, we believe, will be useful to those of our readers who desire to use the microscope in their researches upon the qualities of steel. M. Schott contends that each crystal of iron is an octahedron, or rather, a double pyramid raised upon a flat square base. The hights of the pyramids in proportion to their bases are not the same in different kinds of steel, and the pyramids become flatter and flatter as the proportion of carbon decreases. Consequently, in cast iron and in the crudest kinds of hard steel, the crystals approach more to the cubical form from which the octahedron proper is derived, and the opposite extreme, or the shaft wrought iron, has its pyramids flattened down to parallel surfaces or leaves, which, in the arrangement, produce what we call the fiber of the iron. Between these limits, all variations of hights of pyramids can be observed in the different kinds of steel in which these crystals are arranged more or less regularly and uniformly, according to the quality and mode of manufacture. The highest quality of steel has all its crystals in parallel positions, each crystal filling the interspaces formed by the angular sides of its neighbors. The crystals stand with their axes in the direction of the pressure or percussive force exerted upon them in working, and consequently the fracture shows the side or sharp corners of all the parallel crystals. In reality good steel under the microscope shows large groups of fine crystals like the points of needles, all arranged in the same direction, and parallel to each other. If held against the light in a particular direction, each point reflects the light completely, and a series of parallel brilliant streaks are shown all over the surface. Now, the exact parallelism of the pointed ends or of the streaks of light is one of the most decisive tests for a good quality of steel, and this is not visible quite so frequently as might be generally imagined. On the contrary, a great majority of steel fractures show crystals arranged in parallel groups or bundles, as before described, but clustered together in several distinct crystalline layers, which are not parallel to each other. The consequence is that the needle-points, visible under the microscope, appear to cross each other at certain places, or at least they point in such directions that, if elongated, these lines would cross each other at a short distance in front of the fractured surface. Wherever the crossing actually takes place, a ridge or line is generally visible to the naked eye, and the color of the two parts of the fractured surface which contain the different groups is different, since the light which falls upon one group at the proper angle for reflection will be in such a position with regard to the other group as to throw the points of the crystals into the shade. The one part of the surface, therefore, will appear bright or silvery white, while the other will look dark or grey in color. As usual, inferior specimens are more instructive than the best qualities, because there the peculiarities and faults come out most strikingly. We have seen a piece of a Bessemer steel block from a spoiled charge, in which the crystalline structure of the spiegeleisen was seen in some spaces, particularly at the edges of the air-bubbles, perfectly distinguished from the coarse-grained crystals of the mass of steel all round. This mass, moreover, contained groups of very different character within itself. In a specimen of steel or iron, made by another process, we could discover clearly defined crystals of pyrites, indicating the existence of sulphur in an unexpectedly tangible manner. Repeated melting, heating, or hammering of steel has, in general, the effect of reducing the sizes of crystals, and also of laying them more parallel. Still there seems to be a difference between the treatment which gives parallelism and that which causes the reduction of sizes in the crystals. The former seems to be principally due to the action of the heat, and repeated melting is the great panacea in this respect. The small-sized crystals, or what is called fine-grain, can be obtained by mere mechanical operations. In fact, hammering at a dull, red heat, or even quite cold, is known to produce the effect of making the grain of steel extremely fine. This is a property, however, which is lost by reheating, and at a sufficiently elevated temperature, steel seems to crystallize in large grains, which remain if it is allowed to cool slowly and undisturbed by mechanical action.—*Engineering.*

Ice in Deep Mines.

The main entrance to the pits at Dannemora, Persberg, one of the oldest and most celebrated of the Swedish iron mines, is a natural opening or abyss, of so large a circumference as to require some fifteen minutes to walk around its mouth. A scaffold is erected out so as to overhang this abyss, upon which the hoisting machinery is placed. The observer can look down into this frightful abyss upward of 500 feet, to which point the light of day extends, and beyond which all is shrouded in darkness, save when feebly illuminated by the dim lights of the miners. One of the most remarkable facts connected with this mine is the large quantity of ice which is always present there. Professor Von Leonhard, in his "Popular Lectures on Geology," says: "The deeper you go the more the ice increases. And in order to remove it from the pits it must be raised up in buckets. At some places the ice is 90 feet thick; it forms real glaciers, which are never diminished by any change of external temperature. This fact, however, should not be regarded as contradictory to another, which will hereafter be illustrated, and which is that pits become warmer in proportion to their depth. The phenomenon at Persberg, as we shall see, can be explained on natural principles. When the visitor has reached the bottom he is conducted by his guide into vaulted chambers, through immense regions of ice. Many of these vaults are so large that fifty men can conveniently work in them at the same time." This occurrence of ice in deep mines is not an isolated fact. Ice is found in the pits of Ehrenfriedensdorf, in Saxony. Leopold Von Buch tells us that formerly, in Norway, mining was prosecuted above the region of eternal snow. Wood, for the timbering, could not be had there, and its want was supplied by filling up a drift with water, and allowing it to freeze; passages were then cut through the ice as they were needed, the balance of the ice being left in lieu of wood for timbers. It is also well known, says the *Mining and Scientific Press*, that the ancient Peruvians obtained ores on the Cordilleras, in places elevated above the perpetual snow line. The mines of Rauris, in upper Austria, lie entirely within the glacier region, and most of the shafts open in eternal ice, clear as crystal; the miners' huts are surrounded with ice. On what is known as Gold Mountain one of the shafts is sunk 100 feet through pure glacier ice. A gold mine in the deep valley of the Alps, near Salzberg, is the highest in Europe which is now worked. There are two tunnels near this mine entirely surrounded with glacier ice. The miners of this region undergo great hardships from exposures, and to avalanches, which often sweep them to destruction while going to and fro to their work, or while reposing in their cabins on the hill sides. It is stated by one authority that there is a locality deep within one of the iron mines of Dannemora, already noted, where the mass of ice is 120 yards thick.—*Mechanics' Magazine.*

NEW PUBLICATIONS.

WHEELER'S HOMES FOR THE PEOPLE. Geo. E. Woodward, 191 Broadway, N. Y. Price $3.

This is one of a series of new works on architecture, just from the press of Mr. Woodward, who makes it a specialty to publish this class of literature. Gervase Wheeler, author of the work under consideration, had his manuscript ready for the press some years ago, but unfortunately the building where the work was in preparation was consumed by fire and the work of many weary months was lost. But what was his loss was the public gain, for there have been many improvements in architecture since the author's calamity, which he has introduced into the volume before us. The work is embellished with one hundred engravings of villas, cottages, and country houses of every order of architecture, with plans and estimates of cost.

WHEELER'S RURAL HOMES.

The author of "Homes for the People" has also published through Woodward, 191 Broadway, a similar but less comprehensive work entitled "Rural Homes," in which he not only illustrates plans of a number of cheap cottages, but also gives engravings of a variety of rustic furniture suitable for summer houses and lawns, such as settees, chairs, flower stands, etc. The author also gives hints as to the best mode of plumbing and heating country houses; also a form for drawing a specification, and contract between the landlord and builder. Price $2.

WOODWARD'S RURAL ART. Geo. E. Woodward, Author and Publisher, 191 Broadway, N. Y. Price $1.50.

The volume before us is No. 2 of Mr. Woodward's annual, on the subject of architecture and rural art. It is not unlike Wheeler's works, noticed above, in its general character. Mr. Woodward designs to issue a work of this kind every year, adding all the new features and fashions in the construction and finish of country houses, Either of the above works will be found useful to builders or persons about to erect or furnish country houses.

HASWELL'S ENGINEERS' AND MECHANICS' POCKET BOOK. New York: Harper Brothers.

Mr. Haswell has long been known as one of our most experienced and reliable civil engineers. His Pocket Book is regarded as one of the standard works, for ready reference, in all that relates to engineering. For some time past the author has been engaged in enlarging and revising the matter contained in previous editions, and the result is now before the public. From about 300 pages he has enlarged the book to 650 closely printed pages, and we venture to say that no work of the kind has ever been produced which contained so much information upon the various branches of engineering, condensed into so small a space. The principal tables, rules, estimates, calculations, etc., employed in the mechanic arts, architecture, railroading, civil engineering, steam navigation, are given in the most convenient and intelligible form. Mr. Haswell's new book ought to be in the possession of every engineer and mechanic in the country.

MANUFACTURING, MINING, AND RAILROAD ITEMS.

Philadelphia claims to be the greatest manufacturing city in the world, except London. In 1866 the factories there produced over two hundred million of dollars worth of staple goods.

Turkey has projected three lines of railway, the first from Constantinople to Belgrade; the second from Enos, a short distance west of Constantinople, to Varna on the Black Sea; the third from Enos to Usknip in Northern Macedonia. The contract for them has been awarded, and the means will be furnished by English, French, and Belgium capitalists.

The gold yield for the country for the present year is about as follows: Montana $12,000,000; Idaho $6,000,000; Oregon $2,000,000; Colorado $5,000,000 Nevada $19,000,000; California $25,000,000, and miscellaneous $5,000,000. Total $74,000,000.

The common 60-seat American railway passenger car costs from $4,000 to $5,000 each, while the English style of railway coach introduced on a few of our roads cost about $14,000. There is a wide difference too, in the weight, in favor of the American car. The interest on the greater cost, and the hauling of the extra weight of the English car must be paid for by those who value exclusiveness sufficiently to use them. In cases where the English coach have been introduced here, they have not proved a profitable investment, and there is very little prospect of their being widely adopted.

The coal deposits of Russian America are pronounced valueless, the mineral being found only in small contorted seams. Iron is found in worthless beds of clay, and far up on the Konkon, gold may be obtained but under such circumstances that it is also valueless, being only workable two months in the year. Stains of copper have been found on rocks near Norton Bay, but no ledge or seam.

There is a stone quarried in Cornwall, Eng., called the Polyphant stone, which can be cut by a hand saw with ease when first mined, but in time becomes exceedingly hard. It occurs of a neutral grey color, and also of a green with red spots and is admired by architects for its chromatic effects.

The New York and New Haven railroad have just introduced a new system of warming their passenger cars, by means of hot water circulating through pipes placed under each seat. By following this plan all the heat is economized and thus keeping the feet of the passengers warm, the whole body experiences an agreeable sense of comfort. We hope to see other roads adopting this excellent mode of warming cars.

A train of thirty cars was loaded with railroad iron at the Cambria iron works, Johnstown, Pa., last week, the destination of which is a point on the Pacific Railroad over five hundred miles west of Omaha, Nebraska. The distance to be traversed is fifteen hundred miles, considerably more than half way "across the continent," and all this distance is to be traversed without transhipment of the iron.

The number of Bessemer steel converters now established in Europe, numbers 115, which are capable of producing half a million of tuns per annum. England with fifty-two converters turns out weekly 6,000 tuns. Prussia with twenty-two converters is the next greatest producer, 1,460 tuns weekly. Next comes France with twelve converters and 880 tuns; Austria, fourteen converters, and 650 tuns; Sweden fifteen converters, and 530 tuns. The Bessemer process is worked at one locality only in Belgium, and Italy has two establishments, with a very small yield.

South America does not propose to be outdone on the trans-continental question by its northern compeer. A project is on foot to extend the Valparaiso and Santiago railroad across the Andes to Buenos Ayres. A German engineer, Otto Von Armen, has surveyed the route, a company has been formed, the government has been applied to for a charter and grant of land on both sides of the track upon which they propose to establish German colonies, although liberal inducements will be held out to all other nationalities to settle there. As an instance showing how railroading pays in South America, it is stated that the road from Santiago to Valparaiso has earned during the past year the sum of $910,241, being quite an increase over the previous year.

The experimental elevated railroad in Greenwich street this city has been completed for quarter of a mile from the Battery. At the last meeting of the stockholders the engineer's exhibit of present and probable future cost, having been inspected it was unanimously resolved to proceed with the extension of the road one quarter mile further, to Cortlandt street, preparatory to its inspection by the State commissioners, as required by law.

The Massachusetts State Council, recently by a unanimous vote, annulled the contract made in July with Messrs, Dull, Gowan and White, for completing certain portions of the Hoosac tunnel, including the central shaft. They authorized the commissioners to take possession of all the tools etc., belonging to the State and to make an immediate settlement with the contractors. The reasons for this are that the bids for the contract were much too low and an increase of rates would soon be necessary, and the council are adverse to making any advance in that direction.

Recent American and Foreign Patents.

Under this heading we shall publish weekly notes of some of the more prominent home and foreign patents.

MANUFACTURING BRICKS.—E. W. Crittenden, Pittsburgh, Pa.—This invention relates to certain new and useful improvements in manufacturing bricks, designed for operating on a large scale, and more especially with a view of dispensing with the hard labor and expensive manipulations hitherto required in the process of brick making. The invention consists, 1st, in an improved means for crushing or pulverizing the clay, and bringing it to a proper elastic state to be molded or compressed into bricks. 2d, in an improved means for molding and compressing the clay into bricks, and 3d, in a novel and improved means for drying the compressed clay, or unburnt bricks to render them suitable for burning in the kiln.

SAFETY ATTACHMENT FOR WATCH POCKETS.—Edward Williams, New York city.—The present invention relates to an attachment to watch pockets of wearing apparel, the object of which is to prevent the abstraction or removal of the watch carried in such pocket from the same, without the knowledge or consent of the wearer or owner, thereby obviating all possibility of the watch being stolen when the person wearing it is in a crowd, or otherwise favorably situated for the operations of thieves, pickpockets, etc.; the said safety attachment being of such a nature and construction as to be easily manipulated by the wearer, and to offer no impediment to the free removal of the watch by such person.

MACHINE FOR HEADING AND SQUARING BOLTS.—Albert R. Bailey, New Haven, Conn., and Wilson W. Knowles, Plantsville, Conn.—This invention relates to a new and improved machine for heading and squaring bolts, and it consists in a novel arrangement of dies and a header, arranged to operate in such a manner that a square is formed on a bolt, contiguous to its head, of greater thickness than the body or main portion of the bolt, and the head and square formed on the bolt at one operation.

CORN PLANTER.—J. M. Sampson, Waynesville, Ill.—This invention relates to a new and improved corn planter, of that class in which the seed distributing device is operated by hand, the device being mounted on wheels, and all so arranged that a very simple, cheap and efficient corn planter is obtained.

BRUSH HOLDER.—Joseph Messinger, Springfield, Vt.—This invention relates to a new and improved holder, by which scrub-bushes may be firmly secured to a handle to admit of the brush being used without the necessity of the operator stooping over and working on the knees, as is now universally done. The invention consists in constructing the holder in such a manner that the handle thereof may be turned or adjusted in a position at right angles with the brush, or longitudinally therewith, and the holder at the same time be perfectly simple in construction, and economical to manufacture.

GATE SPRING.—W. W. Sutliff, Town Line, Pa.—This invention relates to an improvement in a spring for a gate or door, and consists of a flat, covered, metal spring, hinged at one end to the back of a gate, while the other end is free to catch in one of a series of notches in a block fastened to the post or frame of a gate or door, which spring, by its pressure, keeps the gate closed when it is not forcibly pushed open.