at that moment.] Ah! There is one of our bottles burst, and here you see is a crack down one side, an eighth of an inch in width. [The other now exploded, sending the freezing mixture in all directions.] This other bottle is now broken; and although the iron was nearly half-an-inch thick, the ice has burst it asunder. These changes always take place in water; they do not require to be always produced by artificial means, we only use them here because we want to produce a small winter round that little bottle, instead of a large one. But if you go to Canada or to the North, you will find the temperature there out-doors will do the same thing as has been done here by the freezing mixture.

Machine-made Chains.

Machinery has been perfected in America, says the *London American*, for the manufacture of chains of every description. The smallest chains as well as the largest are constructed with a surprising rapidity and exactness. Those for trimming jewelry, little larger than an ordinary pin to the largest ship cables.

The machines for the manufacture of watch and other small chains have been brought from America, and are now used at Birmingham, each doing the work of fifty hands, and more perfectly than it is possible to accomplish it by manual labor.

The machines for manufacturing cables have not, we believe, been used in this country, though for some time employed to a limited extent in America. Many of the cables, we may say the great majority, with which the American marine is furnished are now manufactured by the old process in the iron districts of England. For this and other purposes a large amount is yearly imported.

If the chain makers of Wolverhampton desire to retain this foreign trade, or even the domestic trade, they must follow the wise example of the Birmingham gold chain makers in introducing these labor-saving machines. We learn a company has been organized in New York, with a capital stock of $1,000,000, for the purpose of manufacturing chains of every description. They are to manufacture with machinery invented by a gentleman who has spent thirteen years in perfecting it, and for which invention they have paid him the sum of three hundred thousand dollars, or more than £60,000.

Iron and Wooden Ships.

In a letter to the *Times*, referring to the absence of all provisions for the construction of iron-coated ships in the new year's programme for the American navy, Mr. J. Scott Russell writes as follows:—"The explanation is the simplest possible. The entire mercantile steam navy of Great Britain, with the exception only of some old vessels, is of iron. The entire mercantile steam navy of America, without any exception known to me, is of wood. The reason is obvious. Timber is one of the staples of America, and we are obliged to import large quantities of it from America into England. Iron is the staple of England, and America is obliged to import large quantities of it from us. Hence, America builds timber vessels far cheaper than we can. We build iron vessels far cheaper than America can. With these facts before us we can readily infer—1. That there are no establishments, manufactories, or skilled artificers in America prepared for the business of iron shipbuilding. 2. That the introduction of iron in substitution for wood gives to England (the country of iron) the means of attaining and maintaining an ascendency over any other country in the matter of iron fleets. 3. We see why in wooden ships America had the advantage over us, and she had the wit to use it. 4. She now sees clearly that we have in future the advantage over her, and she waits to see if we have the wit to work it."

IMPORTANCE OF GOOD QUALITY IN IRON.—A writer in the London *Quarterly Review* on the iron trade states, that the necessity of employing good iron for rails is now so generally acknowledged, that, in order to insure a superior quality, one of the greatest railway companies in England have established works to manufacture their own iron; and another company, not less important, are just about to follow their example. The writer also thinks that the loss of so many iron ships is to be attributed to the bad quality of metal used in their construction; coinciding in this matter with the opinions repeatedly expressed in the SCIENTIFIC AMERICAN.

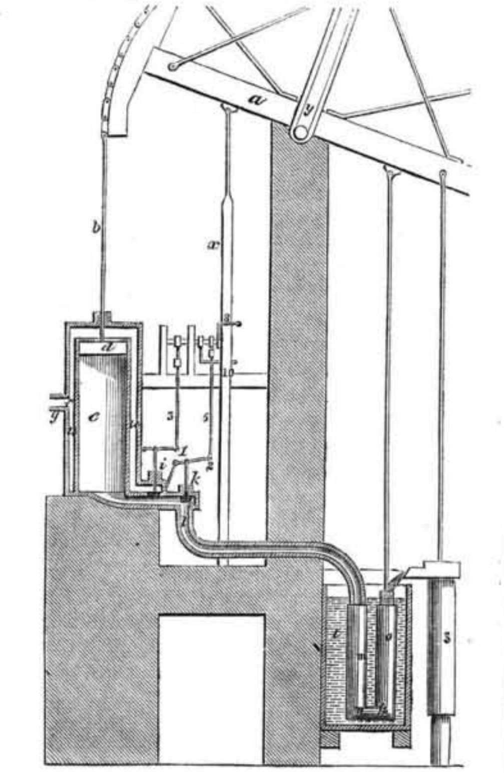
ROMANCE OF THE STEAM ENGINE.

ARTICLE XIII.

JAMES WATT.

The grandeur, the value and the importance of every discovery and invention must be judged by the results it has produced. The steam engine was a giant in swaddling bands for eighteen hundred years, but whenever it began to walk alone, under the improvements of Newcomen and Cawley, its wonderful power became manifest, and it was soon adopted for pumping most of the deep mines in England. As represented in its most perfect condition on page 116, present volume, SCIENTIFIC AMERICAN, it was still a most clumsy and imperfect engine, but it was the best known, and a great improvement over all that had preceded it. The resources of a greater mind than that of any inventor who had preceded him, were now about to be devoted to the investigation of this mighty subject.

The University of Glasgow, in Scotland, has always been distinguished for teaching the practical arts, such as chemistry and mechanism. In the middle of the last century, its professors gave refuge to a most ingenious young mechanic named James Watt, and furnished him with a shop within its walls, where he practiced his trade of philosophical instrument maker, and kept the instruments belonging to the Macfarlane College Observatory in repair. In 1763, a neat working model of Newcomen's engine having been employed by Dr. Dick, professor of natural philosophy, in his lectures, it received some injury and was taken to Watt for adjustment. He very soon understood this motor as no man ever had done before him; and he saw that there was a great loss of heat entailed by condensing the steam in the inside of its working cylinder. It occurred to him that this waste might be saved, and how to do this was a question which frequently occupied his thoughts. In his own account of the invention, he relates with artless simplicity how he resolved the great problem. One Sunday afternoon, having taken a walk abroad in "Glasgow green," his thoughts turned to the experiments which he had been making for saving heat in the engine, when the idea occurred to him, that as steam was an elastic vapor, it would expand and rush into a previously exhausted space, and that if he were to produce a vacuum



in a separate vessel, and open a communication between the steam in the cylinder and this exhausted vessel, he could obtain a vacuum under the piston, and keep the cylinder always at steam-heat, so that no condensation of *live steam* (that which has done no work) would take place. This brilliant idea Watt resolved into the lever of Archimedes, and with it has elevated a world. He was not long in devising and constructing the model to apply his discovery, and he found it come up to his utmost expectations. We omit giving engravings of the first contrivances which he employed, and come at once to the engine which, under his care and direction, was applied to work on a large scale. The accompanying figure is a vertical section of Watts' single acting and separate condensing engine:—*a* is the beam, connected to the piston rod, *b*, by the chain; *d* is the piston; *e*, the cylinder; *f*, the pipe leading from the boiler, which is also furnished with a box containing a valve, which by its rise or fall opens or shuts a communication between the boiler and cylinder; *k*, a valve, which also by its rise and fall opens or shuts a communication between the under side of the piston and the condenser, *m*, by means of the eduction pipe, *l*. The short pipe, *n*, connecting the condenser with the air and water pump, *o*, has a valve at *p*, opening into the pump barrel; in the piston of this pump are valves opening upwards, and at the top of the barrel is a short pipe, having a valve at its extremity opening outwards; *s* is a common pump, with its rod attached to the balanced lever, to raise water from a well or cistern to replenish the box, *t*, in which the condenser pipes and pumps are placed; the rod which draws the water from the mine, and which is also attached to the working beam is not shown; *y* is the axis of the working beam; 1, 2, 3, 5, are levers moving on joints and attached to the valves, *i k*, by means of rods working steam-tight through the sides of boxes; 8, 10, are tappets or projecting pieces on the plug-rod. The pump-rod works through a stuffing box, so that the atmosphere is completely excluded from the interior of the engine; *u* is a space between the jacket and cylinder into which the steam is admitted by the pipe *f*, and from which it is introduced above the piston in the cylinder.

Previously to the engine being put in motion, the air which occupies its internal parts must be expelled. This is done by opening the valves and allowing steam from the boiler to flow into all the pipes and vessels, and the vapor being lighter than the air, expels it downward through the eduction pipe into the condenser, and from that through the valves which open upward in the air pump. The valve *i* is then shut, and cold water being allowed to flow into the cistern, quickly condenses the steam in the condenser pipes, and the steam under the piston rushing through the eduction pipe to restore the equilibrium, is also converted into water—the condensation in both vessels is so rapid, that in practice it may be considered quite instantaneous. The resistance at the under side of the piston being thus removed, the pressure of the steam issuing from the boiler forces the piston into the vacuous part of the cylinder.

The fall of the piston depresses one end of the working beam, *a*; and as the air-pump rod is attached to the opposite end of the lever, its piston is raised to the top of its barrel, and the air and water which had flowed into the condenser, and was prevented by the valve *p* from returning, is now lying above the air pump piston.

But at the instant when the steam piston had reached to nearly the bottom of its cylinder, or had made its stroke, the tappets on the plug frame, *x*, struck the ends of the levers, or spanners, attached to the valves *i* and *k*, and shut them.

The mine-pump rod is loaded with a weight or counterpoise, and it will be obvious, that to get the piston again into the place from which it has fallen, will require a force to be exerted equal to that which had depressed it, or some means must be resorted to, by which the depressing force may be removed or neutralized, so that the counterpoise (the use of which is to raise the plug frame and the steam piston to the top of the cylinder *e*), may have only their weight and resistance to overcome.

This is the steam jacketted Cornish engine of the present day, with only a different arrangement at the beam-head and devices for operating the valves.

CORK-CUTTING MACHINERY.—From the frequent inquiries in the English papers, and the number of patents taken out in this country, there seems to be an earnest demand for a practical cork-cutting machine which will supersede the expensive hand labor now employed in that manufacture. We invite the attention of all persons interested in the matter to the illustration, on another page, of Millar's cork-cutting machine. It seems to us that he has hit upon the true plan of making a machine for this service, as he produces the peculiar drawing stroke required, by the most simple mechanism; and his machine certainly turns out very perfect work.