SCIENTIFIC MUSEUM.

Steam Ether, Air.

In the last number of the Scientific American, page 381, the heat of steam and the operation of the mercury gauge were explained and illustrated; although the article in that number was complete in itself, so far as it went, still this one may be taken in connection with it. There may not be much information in this to experienced engineers, but we know there is much which should be more generally diffused among our people. We quote the following two extracts from exchanges to prove this:

"Combination of Ether with Steam.—The 'Patrie,' Paris paper, says that experiments have, for some years past, been made with ether combined with steam, on board of Government vessels. The result has been that a great saving may be effected, but that the inflammable nature of ether renders it dangerous. It has just been resolved to replace ether by chloroform, and two engines of sixty horse power are to be placed in the Gallie, to enable experiments to be made."

"Rarefied Air Engines.—The Philadelphia Ledger notices an important experiment, now being made by Capt. Ericsson, sustained, it is said, by the capital of an English house. It is to double the pressure of the air, by an increase of 480 degrees of heat; the heat being produced by a very small quantity of fuel. This rarefied air is to drive a piston in a large cylinder, and this piston is to give motion to the water-wheels of a steamer. We find in a late English paper the following paragraph, which looks like the same kind of an experiment:

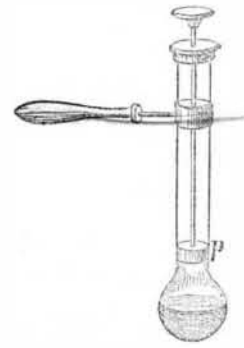
The proprietors of railways will be glad to hear of Mr. Palsey having clearly demonstrated the practicability of his compressed air-locomotive. The expense of coke is very great for the production of steam power, while the expense of coal for the production of air-power will be much less, and the expense of water for locomotives will be altogether saved. The expense of tubes and fire boxes will also be taken away. The first experiment of this invention took place on the 25th ult., the second on the 2nd inst., on the junction, a few miles below Cambridge, on the Eastern Counties Railway. The engine was charged to only 175 lbs. in the reservoir, and ran 5½ miles in 28 minutes, the speed being varied from 12 to 15 miles per hour. A higher speed was attainable by increasing the working pressure of the regulator."

Gas and air have often been tried, as substitutes for steam, but they have hitherto failed: ignorance of the nature of steam has been the cause of this, in the majority, if not all of the cases.

M. Brix, of Berlin, Prussia, in experiments made with water, alcohol, oil of turpentine, &c., proved that there was far more latent heat in water than in either of these fluids. The latent heat of steam he found was 972 degrees; alcohol, 385·2; ether, 162; turpentine, 133·2. This differs by some degrees from the experiments of Dulong and Despretz, of France, but nothing in reference to the relative degrees of heat of the liquids mentioned. The vapor of water (steam) having more latent heat, is not so dense as that of alcohol or ether, and those who get up ether engines seem to overlook this fact, or they are not acquainted with it. The specific gravity of alcohol vapor is 2·5 times that of water vapor; this is about the proportion of latent heat it has below the steam; but this also proves, that equal volumes of these two vapors possess equal quantities of latent heat. "If the latent heat of different vapors," says Graham "be proportioned to their volume, the same bulk of vapor will be produced from all liquids with the *same* expenditure of heat; and hence there can be no advantage in substituting any other liquid for water, as a source of vapor, in the steam engine." So much for any benefit that may be obtained by the use of alcohol, ether, or chloroform, as substitutes for steam. Let us now see what advantage is to be gained by the employment of air.

How do Heat and Water Produce Mechanical Effect.—By the application of heat to water, the water is expanded into vapor (steam) of a bulk 1700 times greater. A cubic inch of water produces, when combined with heat, 1700 cubic inches of steam. A cubic inch of water, converted into steam, will raise 2,125 lbs. one foot high. This is the mechanical value of a cubic inch of water converted into steam by the application of heat. It costs no physical labor at all. Here is the way to work the question:—1700×15÷12=2125 lbs. one foot high. Well, then, a cubic inch of water raised into steam will push 15 lbs. to a distance of 141 2-3 feet; it can do more; can hot air do any more? No. But can this cubic inch of water, raised into steam produce no more mechanical effect? It can produce more. What is it? If the 15 lbs. were pushed through a tube 1700 inches long, by applying cold water to the outside the steam will be condensed to its original bulk, and the 15 lbs. will descend in the vacuum—the steam being re-converted into water—heat converts water into steam, and the abstraction of the heat from it re-converts it into water. This is one of the most important qualities in which steam differs from air; no known degree of cold is capable of converting air into a liquid. "It is," says Lardner, "precisely this quality, giving us the power of re-converting steam into water at pleasure, which enables us to use steam so extensively for mechanical purposes, and deprives air of the same mechanical utility." The annexed engraving, fig. 1, exhibits the principle of the application of steam to produce mechanical effect. This figure consists of a glass tube, about an inch in diameter, slightly expanded into a bulbous form at one extremity, and open at the other; a piston is made, by twisting tow about the end of a piece of straight wire, which must be fitted tightly in the tube by the use of grease. Upon heating a little water in the bulb below piston *p*, steam is generated, which raises the piston to the top of the cylinder. Here the simple elastic form of the steam is the moving power; and in this manner steam is employed in the high pressure engine. The greater the load upon the piston, and the more the steam is confined, the greater does its elastic force become. Again: the piston being at the top of the cylinder, if we condense the steam with which the cylinder is filled, by plunging the bulb in cold water, a vacuum is produced below the piston, which is now forced down to the bottom of the cylinder by

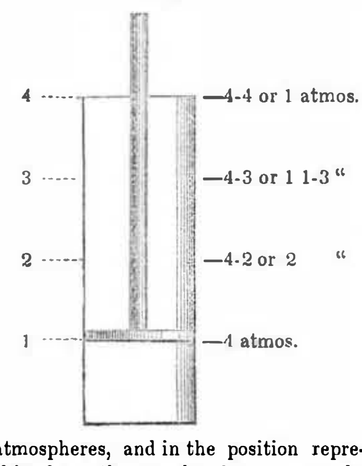
Fig. 1.



the pressure of the atmosphere. In this second part of the experiment, the power is acquired by the condensation of the steam, or the production of a vacuum; and this is the principle of the common condensing engine. In the first efficient form of the condensing engine (that of Newcomen) the steam was condensed by injecting a little cold water below the piston, which then descended, from the pressure of the atmosphere upon its upper surface, exactly as in the instrument. But Mr. Watt introduced two capital improvements into the construction of the condensing engine; the first was, the admitting steam, instead of atmospheric air, to press down the piston through the vacuous cylinder, which steam itself could afterwards be condensed, and a vacuum produced above the piston, of which the same advantage might be taken as of the vacuum below the piston. The second was, the effecting the condensation of the steam, not in the cylinder itself, which was thereby greatly cooled, and occasioned the waste of much steam in being heated again at every stroke; but in a separate air-tight chamber, called the condenser, which kept cool and vacuous. Into this condenser the steam is allowed to escape from above and from below the piston alternately, and a vacuum is obtained without ever reducing the temperature of the cylinder below 212°

Using Steam.—A third improvement in the employment of steam as a moving power consists in using it *expansively*; a mode of application which will be best understood by being explained in a particular case. Let it be supposed that a piston, loaded with one ton, is raised four feet by filling the cylinder in which it moves with low-pressure steam, or steam of the tension of one atmosphere. An equivalent effect may be produced at the same expense of steam, by filling one-fourth of the cylinder with steam of the tension of four atmospheres, and loading the piston with four tons, which will be raised one foot. But the piston being raised one foot by steam of

Fig. 2.



four atmospheres, and in the position represented in fig. 2, the supply of steam may be cut off, and the piston will continue to be elevated in the cylinder by the simple expansion of the steam below it, although with a diminishing force. When the piston has been raised another foot in the cylinder, or two feet from the bottom, the volume of the steam will be doubled, and its tension consequently reduced from four to 4-2, or two atmospheres. At a height of three feet in the cylinder, the piston will have steam below it of the tension of 4-3 or 1 1-3 atmospheres, and when the piston is elevated four feet, or reaches the top of the cylinder, the tension of the steam below it will still be 4-4, or one atmosphere. The piston has, therefore, been raised to a height of three feet, with a force progressively diminishing from four atmospheres to one, or with an average force of two atmospheres, by means of a power acquired without any consumption of steam; but by the expansion merely of steam that had already produced its usual effect.

High-pressure steam is merely low-pressure steam compressed into smaller bulk; for example, if steam, at 30 lbs. pressure, were confined into one half the space, it would exert a pressure of 60 lbs.; in that case its latent heat would be diminished and its sensible heat increased. The working of steam expansively is now the rule among all intelligent engineers, on locomotives, steamboats, &c.

[An exceedingly interesting paper was recently read upon this subject, before the Institution of Mechanical Engineers at Birmingham, England, by D. K. Clark, of Edinburgh, that is, on working the steam expansively on locomotives; we shall present the outlines of the said paper in another number).

A short time ago there was published in a periodical of this city, devoted to the discussion of such questions, an article on explosions on the Western rivers; it was therein stated that American High Pressure Engines, Second Class, working from 80 to 150 lbs. of steam per inch, "seldom cut off at all." This is not correct, and we have the best authority from a Western engineer for saying that no such engine is to be seen on the Western waters. All of the engines on Western steamboats that rate under from 80 to 150 lbs. pressure, have, for the last fifteen years, been constructed to cut off from one-half to three-quarters—varying between these points, but seldom less or more.

There are many erroneous opinions afloat respecting the quantity of fuel required to raise water into steam at different pressures. There is no saving of fuel by evaporating water in a vacuum and no more required in raising water into steam under a pressure of 100 lbs.; the consumption of fuel in the conversion of a given quantity of water into steam, is the same, whatever be the pressure of steam produced. This is a curious but important fact. There is another one equally important to be understood by all engineers; it is this: that with the same boiler, to produce a double mechanical effect with an engine, four times the amount of fuel is required; thus to make a steamboat running only 8 miles an hour, move with a velocity of 16 miles per hour, four times the quantity of fuel will be required. Experiments with the mail steamboats running between England and Ireland, gave such results, and they accord with the experience of many engineers.

Opium Eaters.

It is estimated that there are 50,000 pounds of opium annually retailed in New York city, the greater portion of which is used in destroying the health, the intellect, and the morals of the community.—[Exch.

[Is this so? Every ounce of it is as bad as a gallon of rum, if chewed to satisfy a morbid taste.