He also says that the Nicholson pavement, contrary to many statements, stood the test remarkably well.

"In some places the upper part was charred off, especially where it was new; but the curbstones were in some places actually destroyed, while the Nicholson pavement remained intact. I would suggest as to whether the presence of tar in the wood was not similar in its effects to the presence of the oil in the stone. We may possibly discover a valuable property in tar or oil, from this experience."

Iron structures and parts of structures were badly injured, with the exception of corrugated iron floors supporting concrete arches of masonry, the iron being simply a basis for the masonry.

Vaults built in the tower form, from the cellar up, proved the most efficacious; heavy brick vaults built upon floors are severely deprecated.

The importance of fireproof shutters is earnestly dwelt upon. Mr. Wight says:

"No matter how they are made, so long as they are strong enough; make them double or treble or quadrüple, with air spaces between, but by all means keep out the fire from neighboring buildings, even if you have nothing in your own house to burn. Every fireproof building should have fireproof shutters on every window, whether on the front or on the rear. It is the habit with us to put them on the rear, and very often to leave them off the front. We say "Our building is fireproof; there is nothing in it to burn." But there is something in it to burn, and the very books, papers, furniture and carpets used have proved—as in some of these buildings in Chicago—sufficient to soften an iron beam, and destroy the best constructed floors."

Great emphasis is also laid upon the proper construction of roofs. They should "be made the best part of the building." In a great fire fanned by a hurricane, the current of heated air comes directly down on the tops of the buildings, instead of the fire communicating from house to house. This fact is shown by numerous examples, adduced by the speaker, which we have not space to reproduce, having already exceeded our prescribed limits.

We have seldom read a more instructive discussion, and if Mr. Wight fulfils his intention of writing an elaborate paper upon the subject, he will confer a great benefit upon the public.

POWER PRODUCED BY STEAM, UNDER DIFFERENT TEMPERATURES AND PRESSURES.

At the present stage of our knowledge in regard to the conversion of heat into motion, the steam engine stands foremost as the least expensive and most convenient apparatus to accomplish this transformation. Being founded on the increase in volume of water, when changed by heat into steam, it is easy to calculate the amount of heat required to produce a given power, for the reasons that the amount of the increase in volume of water when becoming steam, and the amount of heat required to accomplish this, are both well known.

To simplify our calculation, let us suppose that we have a long vertical tube 6 inches in diameter, or of 27 square inches, or $\frac{1}{5}$ of a square foot, sectional area. The whole length we suppose to be 144 feet; then the whole contents of the tube would be $\frac{1}{5}\times 144$, or 27 cubic feet. Suppose now we have, at the bottom of this tube, water one inch high; then we shall have 27 cubic inches, or one pound of water. Let us finally assume that we give this water heat enough to convert it all into steam. Then, as it expands 1,700 times, it will just fill the tube, which is 144 feet, or 1,728 inches long. The heat required to change one pound of water into steam is 965 units, and the power produced we may easily estimate by considering that the steam will possess one atmosphere's pressure and be just able to remove the atmosphere from the tube, as this has a pressure of 15 pounds per square inch, or $15\times 27=405$ lb. for the whole sectional surface of the tube, in which a piston might separate the steam from the air. This piston will, by the expansion of the steam, be moved through a distance of 144 feet, and, being subject to the atmospheric pressure of 405 pounds, the force produced by the evaporation of one pound of water will be $144\times 405=58{,}320$ foot pounds.

If this result is accomplished in one minute, we shall have one and two thirds horse power, as 33,000 foot pounds per minute has been adopted for the amount of one horse power. We see, therefore, that the evaporation of one pound of water per minute, or 60 pounds per hour, gives us one and two thirds horse power, and this agrees tolerably well with experience, which has taught that the evaporation of one cubic foot—that is, 63 pounds of water per hour—is amply sufficient for one and a half horse power. As we have seen (p. 184) that one pound of coal is able to evaporate 13 lbs. of water, the evaporation of $5\times 13=65$ lbs. water requires 5 lbs. of coal (producing one and two thirds horse power), or three pounds of coal per hour for one horse power. And this is indeed the ordinary estimate for economical engines with Cornish boilers; locomotives consume double that amount, and even more.

The question now arises: Is it not more economical to raise the temperature of the water higher than only 212°, which only obtains one atmosphere's pressure? Is it not more advantageous to work with a pressure of several atmospheres?

The answer to these questions is affirmative; but it must be remembered that the rule, usually given, that water expands 1,700 times so that one cubic inch of water makes one cubic foot of steam, is only applicable to steam of 212°; at higher temperatures there is a lesser bulk of steam. At 250° Fah. we have increased every inch of water only to 900 inches of steam and a pressure of 30 lb.; at 293°, the volume is 475 inches and the pressure, 60 lb.; at 340°, the volume is 250 inches, and the pressure, 120 lb.

In regard to the heat required: Steam of 212° consumes 965 units of latent heat; steam of 250°, or 38° more, does not require 38 more units, but only 11, as the specific heat of this denser steam is less. At 293°, or 43° more heat than the latter and 4 atmospheres' pressure, we require only an addition of $12\frac{1}{2}$ units of heat; at 340°, or 47° more heat and 8 atmospheres' pressure, we require only an addition of 14 units of heat.

It is thus seen that every additional atmosphere's pressure requires the addition of a lesser amount of heat, while the capacity for heat or specific heat of the steam decreases by an increase of the heat and pressure. Therefore, the same addition of heat has more effect, when applied after a high temperature and pressure have already been obtained, than at a lower temperature and pressure. The figures here given have been obtained, by Régnault, by the most careful methods of research.

If we apply the same reasoning as before to our tube, with steam of 250° Fah. and two atmospheres' pressure we find that the piston is lifted, by a force of $2\times 27\times 15$ lbs., or 810 lbs., through a space of 900 inches, or 75 feet, producing 810×75, or 46,170 foot pounds, for $965+38=1{,}003$ units of heat. When heating the water to 293°, we have 4 atmospheres' pressure, and thus $4\times 27\times 15=1{,}620$ lbs.; and as the water expands only 475 times, it will raise the steam of this pressure to the hight of 475 inches, or nearly 40 feet, and will lift the 1,620 lb. that distance, which is equivalent to 64,800 foot pounds, for $965+81=1{,}046$ units of heat. Finally, for 340°, the steam expands 250 times, fills the tube to the hight of 250 inches, or nearly 21 feet, at a pressure of 8 atmospheres, or $8\times 15\times 27=3{,}240$ lbs.; this, lifted 21 feet, gives 68,040 foot pounds, for $965+128=1{,}093$ units of heat employed.

It is seen that there is an advantage gained, but it is not as great as supposed by many. The pressure of one atmosphere gives 58 foot pounds per unit of heat; 2 atmospheres, 60 foot pounds; 4 atmospheres, 63·5; and a steam engine of 8 atmospheres, 65·5 foot pounds for every unit of heat consumed. But if we take into consideration that, at high temperatures, there is more loss of heat by waste of fuel, radiation, etc., it is evident that the advantages gained may be overbalanced by disadvantages.

In practice, it is customary not to consider the first atmosphere, or 15 lb. pressure, but to call steam of 250° Fah. and two atmospheres, or 30 lb. pressure, one atmosphere, considering only the 15 lb. above the ordinary atmospheric pressure; one atmosphere has, therefore, to be subtracted from our theoretical figures, in order to make them agree with the customary terms used in practice.

A LONG FELT WANT.

There has been a long felt want for a transparent material, which could take the place of glass for many purposes, without the fragility of the latter substance. The substance which comes nearest to these requirements is mica, but in many respects this fails to meet the want. It would seem that the present resources of chemistry might be adequate to furnish to the world such a material as we have named. So far as we are aware, but little experiment has been made toward the attainment of less brittleness in glass. The ancient process of annealing is still solely relied upon; with how much success, let the myriads of broken lamp chimneys globes and mirrors testify.

It would not be necessary, to render a non-brittle transparent and easily molded material valuable, that it should be insoluble in water, but it would be very desirable that it should withstand the effects of considerable heat. Gelatin, of which beautifully transparent plates can be made, is not only soluble but is decomposed by high temperatures. Are the two properties of transparency and brittleness in solids inseparable? We have no general reason, except the fact that most transparent materials are brittle, to justify such a belief.

Chemistry may yet render glass as little liable to breakage as hard rubber. Could this be done without change in its other characteristics, the utility of glass for general purposes would be increased a thousand fold. The man who can do this cheaply would supply a process of incalculable value.

Business and Personal.

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