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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 145,

For the Week ending October 12, 1878.

RELATION BETWEEN THE GRATE SURFACE AND THE HEATING SURFACE OF BOILERS.

The theory that for proper efficiency there must be maintained certain definite relations between the grate surface and the heating surface of boilers, so long held and persistently defended by engineers and boiler builders, has of late years suffered so many attacks as to be no longer tenable; yet even now there are many of its defenders who refuse to acknowledge the weakness of their position and take up the stronger one which is offered to them in the indisputable fact that the service of a boiler depends more upon the manner of its firing than upon any other special condition—complete combustion and slow consumption producing the best results.

In one way this fact is clearly demonstrated by the new style of locomotive in use on the Reading railroad for burning the hitherto useless anthracite culm. The dimensions of their common locomotive firebox are 60 and 66 by 32 inches; the new design is 8 feet 6 inches long by 7 feet 6½ inches wide; the heating surface of the firebox is 106 square feet, and of the combustion chamber 26 feet, making a total of 982 square feet. The grate rest is between water bars to prevent them from burning out, and the area is 64 feet. The consumption of coal is only 16 pounds per hour per square foot of grate surface against 40 to 60 pounds in the ordinary locomotive.

The fuel remains perfectly quiet in the firebox, the consumption is slow, the steam is more freely made than in the common style of locomotive boiler, and no smoke or sparks (an assurance of complete combustion) are ejected from the smoke stack.

This is an instance of superior boiler service obtained with much smaller consumption of coal, and that of an inferior quality, per square foot of grate surface, than old practitioners would have deemed possible. Its success must lead to extensive trials in this direction and greatly modify general practice.

Not long since a protracted series of trials was made by a board of experienced engineers to determine the relative value of as great a departure in another direction from the common practice of firing—the reduction of a stationary boiler grate surface from 17 square feet to 3 square feet, and the burning of the larger portion of the coal, reduced to a fine powder and injected on a current of air into the heated firebox, instead of consuming it all on the grate.

To begin with, most carefully conducted and repeated trials were made with Cumberland lump coal burned in the usual way on the full grate surface, 17 square feet; then, with the surface reduced to 3 square feet, the new process was repeatedly tried, in which 40 per cent of the coal was consumed on the grate, and 60 per cent injected over it and burned in the powdered condition.

The results showed an average gain in the calorific value of the coal of 30 per cent in favor of the new method, and the thoroughness of the combustion was evidenced by the total absence of smoke escaping up the stack.

In one of these instances the grate surface was, relatively to the boiler, very much larger, and in the other very much smaller than was before used, and in neither case was the calorific value of the fuel, or, what in this connection amounts to the same thing, the service of the boiler, dependent upon the relative area of the grate, but entirely upon the conditions—widely unlike as they at first sight appear, yet the same in principle—that assured complete combustion and slow consumption.

In the one case a much less weight of coal is consumed per hour per square foot of grate surface, and in the other a very much greater than is done in common practice; and yet both methods are found to lead to the same point.

The ratios of 25 or 30 to 1, as representing the relative areas of heating and grate surface in common practice, refer only to the best conditions obtained by the ordinary method of firing, which generally implies extreme waste of fuel: there is no direct relation between them.

The new methods of mechanical stoking—gradually sprinkling fine coal over the fire surface, feeding the fire from below, etc.—are all opposed to the old idea, as are also the radiating brick arch over the fireplace, the use of the steam jet for blowing the fire, the two fire boxes, consuming the smoke by their alternate action, and several other approved devices which are growing into use.

The manner of firing on which the old theory was based is too expensive in these times; new methods, each with special conditions and advantages, will be gradually substituted, and the most profitable investigations for steam engineers will be into the conditions most favorable for the highest economy in fuel and labor and the least dependent upon the unskillful fireman.

WAGES AND THE COST OF LIVING.

Comparing the present market prices of all the articles of necessity and luxury that go to make up the cost of living, with the prices that obtained when wages were higher, it will be seen that wages have fairly held their own. And if men will make the same comparison with regard to men's earnings and purchases, twenty, fifty, a hundred years ago, they will see that—thanks to cheaper and more rapid means of production and carriage through mechanical inventions—in every element of living, in housing, clothing, food, luxuries and the rest, the workman of to-day has infinite advantages over his father, grandfather, or great-grandfather. And he enjoys a multitude of privileges and benefits, in stable government, personal liberty and protection, gratuitous education for his children, free medical attendance, pure water, lighted streets, and other untaxed advantages which his ancestors never dreamed of or hoped for. His wages are higher, and his money will buy more, dollar for dollar, than his father's would.

We do not say that the real as well as relative cost of living is not advanced by every step forward in civilization. For ten days' work an East India Islander, according to Wallace, can manufacture or earn sago cakes enough to last him a year; and less labor will keep him supplied with the limited clothing he needs. A man needs more clothing here, and a greater variety of food; yet when it comes to the absolute necessities of men—the minimum cost of living—a very small portion of a man's yearly wages will keep him alive and comfortable. Thoreau built him a shanty in Waldon Woods and lived a year in it at a total cost of twenty-seven dollars, and never approached either squalor or starvation. The experiment is of value only in that it proves it possible for a man to get as much bare living here for a given amount of labor as a Polynesian can. If one wants more—and very properly most men do want more—one must work for it; and our civilization happily offers at once more opportunity for labor, and infinitely more to be had for the proceeds of such labor, than have been attainable in any other land, under any other social or industrial conditions. And we doubt whether there was ever a time when industry and economy—using the term in its true sense, of judicious management—would or could have met with a surer or more generous reward, than in our own land to-day.

MAGNESIAN LIME VS. PURE LIME FOR MORTAR.

The cause and the remedy for the white efflorescence which so commonly disfigures brick house fronts are the subjects of a recent paper by Mr. Henry Pemberton, published in the *Journal of the Franklin Institute*. The causes are two: first, the existence of silicate or other salts of magnesia in the brick clay, converted into sulphate of magnesia, in the process of burning in the kilns, by the sulphurous vapors from the coal; and secondly, the employment of lime containing magnesia for the mortar used in the walls, which, by the absorption of the sulphurous vapors of the coal gases in the general atmosphere of the city, becomes converted into sulphate of magnesia, and, being dissolved by the rain, penetrates the substance of the more or less porous bricks, efflorescing ultimately upon the surface.

This efflorescence is also an indication of a serious evil, namely, the disintegration of the mortar uniting the bricks, causing the washing out of the joint and consequent destruction of the buildings, or compelling their refilling and repointing at heavy cost.

The percentage of magnesia found in brick clay rarely, if ever, exceeds one half of one per cent, and although this quantity, when converted into the soluble sulphate, would be drawn by capillary attraction to and accumulate upon the surface of the bricks, yet, being washed off by successive rains, the supply from within would soon be exhausted if not fed from some other source, and this source is found in the magnesian lime used in the mortar.

Pure lime is abundant and cheap, but the prejudices of the workmen prevent its use. The behavior of a mortar made from magnesian lime is so different from that made from pure lime as to render it easy to understand why the prejudice exists.

Magnesian lime, says Mr. Pemberton, forms when slaked a gelatinous, fatty mass, absorbing much water and permitting a large amount of sand to be mixed with it. The bricklayer, when using it, spreads out the mortar on the surface of the brickwork already laid as far as he can reach, without removing his feet from their position. He then places the brick in line upon this bed of mortar, placing, as he does so, a little mortar on the end of each brick as laid, until perhaps seven or eight or more are in place, then points up the brick with the trowel on the face of the work.

With pure lime mortar this plan will not do. The mortar when laid on the brickwork becomes soon so firm—being less gelatinous or pasty than the magnesian—that two or three bricks only can be laid before it sets, or becomes so dry as not to make a proper bond with the new bricks and those already laid. Consequently the bricklayer, accustomed to the magnesian lime, promptly and persistently rejects the pure lime as worthless, since he cannot execute the work expected of him in a given time, nor, probably, if used by him, would the bricks be securely and properly bedded. The purest quality of lime is found, for instance, within a few miles of Philadelphia, and is sold at a lower price than ordinary builders' lime, and yet it will not be accepted or used by the builders for the reasons given above.

An analysis of the lime used in a block of handsome dwellings now being erected there shows it to contain nearly 38 per cent of magnesia, which is readily attacked, dissolved and formed into a soluble salt (Epsom salts) by the sulphuric acid which abounds in the atmosphere of cities where coal is burned, and which consequently must be washed out and destroyed.

In some parts of the country, as in Pittsburg, for example, the only lime available rarely contains more than five to six per cent of magnesia, and often less than one per cent, but the bricklayers are accustomed to it, know no other, and use it with entire satisfaction; and no incrustation occurs on the buildings there, notwithstanding the enormous consumption of coal in the city and neighborhood.

The Pittsburg bricklayers would undoubtedly object to