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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

the more easily worked magnesian lime of Philadelphia, because it requires a different manipulation. Such are the prejudices formed under the influence of local habit.

NOVEL APPLICATIONS OF DYNAMITE.

From a long article on trials with dynamite in one of our London exchanges, we condense the following valuable report of its use in breaking up a wrecked iron ship and otherwise:

The wreck was that of the steamship Oscar, of Leith, which ran ashore at Whitby; she was of 1,258 tons gross, 824 tons net register, 261 feet long, 31 feet beam, 23 feet depth of hold, and 110 horse power. A futile attempt was made to break her up with gunpowder; subsequently dynamite was tried.

A charge was made up in a common canvas hose from 9 to 10 feet long, consisting of 30 pounds of dynamite, with an extra 10 pounds in a lump fixed firmly to the end. The diver took this charge and placed it in the lazarette, the heavy end being fixed against the stern frame and the tail part trailing forward along the starboard side as the wreck lay on that side. After the diver cleared out the charge was exploded, the result being that the stern frame and all the steering gear were smashed out and lay on the rocks, and the starboard quarter was parted right away. The next charge, placed in the port bow close to the fore foot, blew the fore foot away and ripped the port bow plates through, and the wreck fell over separated from the keel upward.

Several small charges were then exploded in the cylinders and on the condenser, breaking them up. A five pound charge, lowered into the crank pit, blew down the remaining part of the engines and condenser in such an effectual manner that the diver was enabled to send up the condenser and about two tons of brass in half an hour the next day.

The charges were fired by the ordinary "time sea fuse," a long length of which takes as much as a quarter of an hour or twenty minutes to burn to the charge. This is a great loss of time in a tide, and in future electricity will be applied.

No trouble was taken to make the canvas hose that inclosed the charges waterproof, though dynamite is practically unaffected by water for several hours. Put in India rubber hose it would remain for a long time under water without being injuriously affected. In work of this character it is completely successful where gunpowder and gun cotton have failed, and being of a plastic nature, it possesses the advantage of being moulded and pressed into any shape, such as angles, square holes, etc.

Iron masts, beams, chains, and wire rope are cut off by tying small canvas hose containing dynamite round them, and then exploding it.

In the instance of the iron steamship City of Venice, which went ashore on the rocks, after every other plan to raise and haul her off had failed—she had rocks through her bottom in some places four feet high—dynamite was tried. The rocks protruding through the vessel were first removed by use of small charges; the tops of the rocks outside of the vessel were then blasted away, and the vessel was got off without further injury, and saved.

So powerful and effective an agent should be better understood and applied to more purposes than it is. Not only can it be used to remove rocks surrounding a vessel, but in the case of a vessel stranded on a sand or mud bank a channel could be excavated, it seems to us, by the use of long tubes filled with the dynamite; and for open cuttings for roads such tubes could be laid in furrows made by machines like those in use for excavating for drain tiles, and fired with good and economical results.

PROGRESS OF WESTERN MINING OPERATIONS.

The action of the Committee of Security of the New York Mining Exchange, in sending their chairman to Colorado for the purpose of obtaining, by personal observation and in other ways, more accurate knowledge of certain mining properties which are offered in this market, is worthy of high commendation. In a two months' investigation he has found that actual frauds have, in some cases, been forced upon the market here, and that most of the other mines have been overrated.

The dishonest and speculative element, though much weakened by the many successful legitimate enterprises that have been established there within the past two or three years, is, in fact, still powerful, and will finally yield only to the persistent force of public opinion as represented by the scientific and mining press and the various mining exchanges of the Eastern cities, whose aim it should be to discover and explode all mining bubbles.

Our opinion, that if the truth concerning the mining interests there were generally known, a large amount of Eastern capital would be invested there, is fully indorsed by this gentleman, as it must be by all conversant with the conditions.

Intensified by the severe lessons of the past the conservatism of Eastern capital must, ere long, remove the reproach of speculative mining which has so retarded the growth of Colorado, and which is still the curse of the mining regions farther West.

We do not by any means wish to imply by this that intelligent observation and good judgment cannot find as many opportunities for profitable mining on the Pacific slope and elsewhere as in Colorado, but simply that the elements opposed to legitimate and favoring speculative mining exist there in fuller life and vigor, and apparently control nearly all operations. In evidence we quote from a late San Francisco exchange: "The mining share market is now being flooded with outside stocks, every day witnessing the placement of some new wildcat, which seemingly is selling like hot cakes, but for the genuineness of which we would not vouch. Under the present buoyancy many shares may be sold at reported prices, but the advance is altogether too sudden to be fully real, and in this respect we would caution parties about being over-anxious to invest, for this is the opportunity for the free manipulation of all those claims that have no merit whatever."

The mainsprings of these conditions are the continued remarkable output of some of the Bodie District mines, and the new lease of life which it is supposed the Sutro tunnel will give to the mines of the Comstock lode, the output of the Bodie mine alone, for the month of August, being estimated at $700,000.

From the Black Hills there are encouraging reports of the quality and abundance of the gold and silver ores and of the activity of the mining business; already 135 stamps are at work on ore from one mine there, and 80 at another, from which last $40,000 in gold was cleared up in about a two weeks' run.

From Utah, too, and Montana further valuable discoveries are reported, and an instance in Montana of important gold diggings, from which three men took out over 300 pounds of gold in less than four months, using only a hollow log for a sluice box.

The establishment, in all the mining districts, of concentrating and smelting works, which purchase ores from those miners who have not the means for erecting reduction works of their own, or whose knowledge of the art is imperfect, has everywhere given great impetus to the mining interests; and as the system grows in favor and the interests are better understood and adjusted, as they must soon be under competition, it will be found, we think, that this division of labor will add profit and safety to mining operations.

THE BOSTON WHITTLING SCHOOLS.

Formerly all American schools were whittling schools; but the art was practiced surreptitiously, the soft pine desks and benches furnishing the only whittling material. With the advent of highly finished hard wood school furniture, all jacknife practice in school was rigorously suppressed; and for a generation or so the art has fallen into decadence. It has revived, however, under improved conditions, the natural spirit of constructiveness—usually called destructiveness—incident to boyhood, being made the basis of systematic training of the most enjoyable and useful sort.

The pioneer institution is the Boston Whittling School, a private enterprise housed by the city. The school-room has been fitted up with work benches, divided into four foot sections, and each boy is furnished with such tools as he may need. Thirty two were admitted the first year, their ages ranging from twelve to sixteen. The school report says that perhaps twelve of them had received some instruction in the use of the jig saw and knife, but none had had any previous training in wood carving or the use of the chisel. There were more applicants for admission to the school than could be received. If any boy was absent two successive evenings, his place was taken by another. A rank list was kept and pasted on the wall, and each boy knew how his work was estimated by consulting the list. A course of twenty-four lessons in wood carving was prepared with special reference to secure the greatest amount of instruction with the least expenditure for tools and material. It was not designed to make finished workmen in wood carving, but to take advantage of the natural inclination toward handicraft, the Yankee taste for whittling which belongs to most boys, and to develop it and guide it to useful applications.

The experience of the founders leads them to the belief "that it would be easy to establish, in connection with all our grammar schools for boys, an annex for elementary instruction in the use of the half dozen universal tools, *i. e.*, the hammer, plane, saw, chisel, file, and square. Three or four hours a week for one year only of the grammar school course would be enough to give the boys that intimacy with tools and that encouragement to the inborn inclination to handicraft, and that guidance in its use, for want of which so many young men now drift into overcrowded and uncongenial occupations, or lapse into idleness and vice."

Northern and Central Europe have been doing this or similar work for years; and such teaching has done very much to hasten the industrial development of the countries that have tried it.

THE RESTORATION OF CUBA.

An official decree, dated September 21, provides that, from the date named, "All mules, horses, cows, and oxen, and all machinery and implements for agricultural purposes, comprised in articles 231 and 614 of the Custom-house tariff sheet, imported into ports of the provinces of Puerto-Principe and Santiago de Cuba, shall enter duty free for the term of one year. The term may be extended to another year according to circumstances. Said animals and goods can be imported from any country, and under any flag."

The ports designated for importation are Nuevitas, Gibara, Baracoa, Santiago de Cuba, Guantanamo, Manzanillo, and Santa Cruz. The franchise is accorded only to the provinces mentioned, with the object of repairing the damage inflicted by the late insurrection. A provision of the decree prohibits the introduction of the animals and goods referred to into the other provinces of the island either by sea or land.

This decree gives signal emphasis to our recent remarks with regard to the present importance of Cuba as a field for American enterprise. Now that the new patent law of Spain offers abundant protection for novelties and new inventions on terms of great liberality to inventors and introducers, there is no reason why the United States should not secure and hold a large share of the growing Cuban trade. It will pay our inventors and manufacturers to occupy the field promptly.

OUR SEPTEMBER EXPORT EDITION.

The September issue of the SCIENTIFIC AMERICAN Export Edition presents by far the most comprehensive and varied array of valuable information and important trade announcements ever brought together in a trade journal. The table of contents embraces upward of two hundred articles bearing upon recent advances in the several departments of pure and applied science, notable events, productive industry and commercial enterprise; and is illustrated by upward of one hundred engravings. The advertising pages are not less instructive and valuable, including as they do the business announcements of nearly one hundred and fifty of our leading mercantile and manufacturing establishments, with two hundred and twenty-five engravings of approved machinery and the like.

The influence of such a periodical on the foreign trade of the country can scarcely be overestimated. The high value of its general contents, and its convenient and substantial form, insure its careful perusal and preservation; and its wide circulation makes it an efficient as well as worthy exponent of American industrial and commercial progress. It goes to every American Consulate, the natural resort of all in search of information in regard to American affairs. It also goes to, and is on file in, a multitude of foreign libraries and reading rooms, and the assembly rooms of scientific and industrial societies and boards of trade. And every steamer sailing from this port is furnished with copies for the instruction and entertainment of the passengers. The liberal use of its advertising pages by our enterprising manufacturers is sufficient proof of their appreciation of the facilities thus offered for reaching and interesting foreign buyers.

A REMARKABLE WASPS' NEST.

A few days ago the time ball on the Western Union Telegraph building in this city had to be replaced by a new one. The workmen, who went up to remove the old ball had no sooner begun their work when they suspended operations with surprising abruptness and unanimity. A colony of wasps had taken possession of the ball, and were quite unwilling to surrender their airy quarters. Indeed, it was with considerable difficulty that they were finally smoked out.

The surprising feature of the affair was not so much the unwillingness of the wasps to surrender their home as their taking up with it in the first place. When in position for its noon fall the ball rests at the top of a pole, 255 feet above the sidewalk; and, at the tick of twelve, drops 20 feet. That the wasps should have borne with this daily disturbance of their dwelling place is proof of their tenacity of purpose, to say the least. Whether their persistence was due to practical wisdom or to inherent stupidity is a question for Sir John Lubbock or Prof. Riley to decide.

THE AMERICAN PRIZES AT PARIS.

Although the American exhibitors at Paris were far too few in number to do complete justice to our country's industrial achievements, the proportion of prizes announced shows the display to have been fairly creditable so far as it went. Just how many those prizes are it will be impossible to say positively until the official list is published. The (Paris) *Continental Gazette*, of September 12, however, gives a classified list of American prizes—"unofficial, but to be depended on so far as it goes"—which contains the names of five hundred and twenty exhibitors. Eight of these were awarded grand prizes; ninety-seven received gold medals; one hundred and thirty, silver medals; one hundred and seventy-six, bronze medals; one hundred and eight were honorably mentioned; and three—the Pacific Coast Mineral Exhibit, the Oregon State Commission, and the United States Department of Agriculture—got diplomas of honor.

The full significance of these awards cannot be appreciated without a comparison of the numbers of American and other exhibitors in the several departments, so as to show the percentage of prize takers among them. That cannot yet be done; enough is known, however, to show that there has been no serious falling off in American progress, notwithstanding adverse times.

A New White Paint.

After some ten years of laborious and costly experiments, Mr. T. Griffiths, of Liverpool, has succeeded in producing a new mineral white by the aid of sulphide of zinc, which entirely eclipses white lead and the old zinc white (oxide of zinc), by having much more "body" or covering power and more permanent qualities than either of these, and, moreover, not being of a poisonous nature like white lead, does not affect the health of those who manufacture or those who use it. The white sulphide of zinc is precipitated, washed, calcined, levigated and dried, the product being the most perfect white pigment hitherto obtained.