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Contents:

(Illustrated articles are marked with an asterisk.)

OSCILLATIONS OF WATER IN STEAM BOILERS.

The peculiar oscillations of water in steam boilers, as indicated by the steam gage, have been a subject of common remark. The causes for these oscillations are imperfectly understood by many in charge of such boilers, and in conversations with engineers of justly high reputation, we have found that certain causes of this fluctuation in hight are unrecognized.

We may regard the following propositions as thoroughly established laws.

First, the pressure of a homogeneous liquid is as its depth. Second, a liquid subjected to pressure from a supernatant fluid, obeys the same laws of pressure as though it were free from the pressure of the over-lying fluid, and the degree of pressure thus sustained upon its surface does not modify or create exceptions to this rule. Third, if the supernatant fluid be a gas, and the liquid upon which it rests be water, a certain amount of the gas, increasing with the pressure, will be dissolved in the water. Fourth, in the absence of nuclei, which serve by their adhesion to assist the escape of a gas from a liquid supersaturated by that gas, the escape will be irregular, unequal, and will partake of the nature of an explosion. Fifth, in the absence of nuclei, the boiling points of liquids are higher than when such nuclei are present. Sixth, when a liquid is agitated so as to render it of unequal depths in different parts, the pressure upon the bottom of the containing vessel and upon the sides against which the liquid rests will be unequal.

A pressure gage, attached to any one point in the side of a vessel thus agitated, would show by its fluctuations the variations of pressure at that point, provided they did not succeed each other so rapidly as not to give time for this gage to act, in which case it would only show the mean pressure.

A water gage is only a form of pressure gage, communicating at the top with the supernatant steam, and at the bottom with the water upon which the steam rests. The pressure of the column in the gage back toward the interior of the boiler is equal to the weight of a column of water having for its base the section of the aperture which connects the boiler and gage at the bottom, and of a hight equal to the hight of the water in the gage above that aperture, added to the pressure of steam upon the upper end of the column. The pressure outward toward the gage is equal to the weight of a column of water having the same base as before, and of a hight equal to the depth of the water in the boiler above the aperture connecting the boiler and gage at the bottom, added to the pressure of the steam upon the top of the water column as before.

When both steam and water are at rest, the water, obeying the same laws of pressure as though there were no supernatant steam pressing upon its surface, seeks and finds a common level in both boiler and gage.

In a boiler supplying steam to an engine, or blowing off steam, the state of internal affairs is *never* one of rest. To suppose the contrary would be to suppose a uniform pressure maintained, a constantly uniform heat applied to all parts of its heating surface, and the escape of steam from the water unattended by ebullition.

That the pressure is never a constant quantity where steam is generated in a closed vessel, any one may see by watching a steam gage attached to such a vessel. The indication of fluctuations in pressure may also be detected in the variable sound of the steam when a boiler is blowing off. It is for this reason that in testing the evaporative power of boilers, it has been found necessary to eliminate the element of variable pressure, by allowing free escape to the steam, so that the pressure is constantly that of the atmosphere only.

We do not, however, regard the constant short bubbling of water in boiling as of much effect in producing the fluctuations of water indicated by the water gage. There are two causes, however, which are sufficient to account for such oscillations.

In the absence of nuclei the steam is generated under tension and escapes with a sort of explosive action; this occuring at one end of a boiler would raise a wave on the surface, which wave would travel along the surface of the water precisely as it would in an open vessel, and when this wave reaches the end of the boiler where the water gage is attached, the water would rise in the gage and recede with the recession of the wave.

Where a boiler is supplying steam to an engine performing variable work, the supply of steam will not be uniform, and the pressure in the boiler cannot be uniform. Whenever the pressure is diminished suddenly the steam escapes from the surcharged water like the gas from so-called soda water, and the volume of mingled steam and water expands; the water in the gage, obeying the same law as the water in the boiler, except in so far as its temperature may be less.

These causes would account for the oscillations of the water even admitting a uniform heat to be maintained in the furnace, a supposition which variations in draft, variable condition of the fire, and quality of the fuel, etc., forbid.

Where two or more boilers supply steam through a common supply pipe, connected to the boilers by branch pipes, the elements of variation in pressure must be still more multiplied, a point upon which it is unnecessary to dwell.

A consideration of the facts we have thus explained coupled with observation, will enable the intelligent reader to determine the causes of peculiar oscillations in individual boilers.

DIRTY SHOPS AND SLOVENLY WORKMEN.

Charles Reade has asserted that workmen are a dirty set and a reckless set. Is this true of American workmen? His observations have been confined to English workmen; would he have occasion to modify the general character of his statement were he to visit and inspect American shops?

Candidly we must say there would be too much in the general want of cleanliness and order in our workshops to justify the assertion. The shops in which cleanliness and order prevail are rather the exception than the rule; and the individual workman who, in the midst of all the carelessness which prevails in this regard, maintains a scrupulous care for personal cleanliness, order in the arrangement of tools, and method in the performance of his work, may be regarded as a rising man.

On our occasional journeys in those most disagreeable conveniences of the age, horse cars, at times when workmen are returning from their daily work, we frequently notice them with begrimed faces and smutty hands, on their way to homes perhaps no less attractive than their persons.

If this were compelled by circumstances, and the unavoidable conditions of their toil, it would be unkind indeed to find fault with it. We should indeed be the very last to look down upon the necessary accessories of honest toil, and, if any American workman is so situated that he *must* utterly disregard cleanliness, let it be distinctly understood we do not complain of him. But cases of this kind are rare, if they exist at all. What then is the reason for the inexcusable slovenliness of a large majority of workmen?

The first reason is that proprietors and overseers do little or nothing to encourage tidiness in their subordinates. They too often look upon a man who is making attempts to keep himself and his work-bench tidy, as a cat in gloves who will catch no mice, and speak contemptuously to him of being afraid to dirty his hands, although his hands may at the time bear the honorable evidence that his duty has been faithfully performed. But tell us pray, is it necessary that they should bear that evidence home with them? Is it necessary that the face should be soiled as well as the hands, and that clothes should be smirched as well as hands and face?

In imagination we hear some mechanic exclaim, "I should like to see that editor do my work a little while, and keep himself clean! I guess he would find it harder work than sitting in his comfortable office and finding fault with us poor fellows, who have no such good luck!"

To whom we reply that, good luck or not, we often sigh for the light-hearted days, when we did just such work, and earned thereby a good appetite and the means wherewith to gratify it; and further we know that you can't get down on your knees in sand, and face your molds with powdered charcoal, and perspire amid a cloud of black dust, and keep your faces and shirts white. Bless you, we know all that, learned it years ago, but it is not *you* we find fault with. It is that slovenly chap who goes in to work at his lathe, on Monday morning, with a clean shirt on, and who, in less than half an hour, has managed to get two or three streaks of black oil down his back, and sundry patches of it on his face, while the handle to every tool on his lathe and even the lathe itself is japanned with the same unctuous material. We can see the use of the black dust and perspiration in a foundery, but we don't see the necessity of a man in a well-ordered machine shop, painting himself up like an Indian on the war-path, and carrying it home with him to the annoyance of those who are, perhaps, obliged to sit in the same seat with him, and who do not care to get into too intimate contact with black-grease and oil.

Personal cleanliness leads to order in work and business, and elevates the moral character of all who exercise it. It is a virtue second only to godliness, and exercises not only a benign influence upon moral character and physical health, but upon intellectual growth.

Would proprietors and superintendents enforce more thorough order and cleanliness in their works, and encourage it in the habits of their employés, they would get more and better work for their money, would render their help more manly and honorable in the discharge of their duties, elevate the character, and increase the welfare of the working classes throughout the world.

ANNOUNCEMENT FOR 1870.---A SPLENDID WORK OF ART AND CASH PREMIUMS TO BE GIVEN.

The SCIENTIFIC AMERICAN enters its twenty-fifth year on the first of January next, and to mark this period of a quarter of a century in which it has maintained its position as the leading journal of popular science in the world, we have purchased from the executors of the estate of the late John Skirving, Esq., and propose to issue on New Year's day, the fine steel engraving executed by John Sartain, of Philadelphia, entitled

"MEN OF PROGRESS—AMERICAN INVENTORS."

The plate is 22x36 inches, and contains the following group of illustrious inventors, namely, Prof. Morse, Prof. Henry, Thomas Blanchard, Dr. Nott, Isaiah Jennings, Charles Goodyear, J. Saxton, Dr. W. T. Morton, Erastus Bigelow, Henry Burden, Capt. John Ericsson, Elias Howe, Jr., Col. Samuel Colt, Col. R. M. Hoe, Peter Cooper, Jordan L. Mott, C. H. McCormick, James Bogardus, Frederick E. Sickles.

The likenesses are all excellent, and Mr. Sartain, who stands at the head of our American engravers on steel, in a letter addressed to us says "that it would cost $4,000 to engrave the plate now," which is a sufficient guarantee of the very high character of the engraving as a work of art.

The picture was engraved in 1868, but owing to the death of Mr. Skirving, a few copies only were printed for subscribers at $10 each. A work embracing so much merit and permanent interest to American inventors, and lovers of art, deserves to be much more widely known. We propose, therefore, to issue, on heavy paper, a limited number of copies at the original price of $10 each, to be delivered free of expense. No single picture will be sold for less than that price, but to any one desiring to subscribe for the SCIENTIFIC AMERICAN, the paper will be sent for one year, together with a copy of the engraving, upon receipt of $10. The picture will also be offered as a premium for clubs of subscribers as follows to those who do not compete for cash prizes:

For 10 names one year $30 one picture.
" 20 " " " 50 " "
" 30 " " " 75 two pictures.
" 40 " " " 100 three "
" 50 " " " 125 four "

In addition to the above premiums we also offer the following cash prizes:

$300	for	the	largest	list of subscribers
250	"	"	second	do do
200	"	"	third	do do
150	"	"	fourth	do do
100	"	"	fifth	do do
90	"	"	sixth	do do
80	"	"	seventh	do do
70	"	"	eighth	do do
60	"	"	ninth	do do
50	"	"	tenth	do do
40	"	"	eleventh	do do
35	"	"	twelfth	do do
30	"	"	thirteenth	do do
25	"	"	fourteenth	do do
20	"	"	fifteenth	do do

Subscriptions sent in competition for the cash premiums must be received at our office on or before the 10th of February next. Names can be sent from any post office, and subscriptions will be entered from time to time until the above date. Persons competing for the prizes should be particular to mark their letters "Prize List" to enable us easily to distinguish them from others.

Printed prospectuses and blanks for names furnished on application.

WORK PERFORMED RY THE HUMAN HEART ESTIMATED IN HORSE POWERS.

That wonderful little pumping engine which we all carry around in our bosoms, and which runs without cessation till death ruthlessly closes the throttle, performs an amount of work so great as to be almost beyond belief till substantiated by arithmetical calculation.

If we scrutinize the mechanism of the heart, we shall find that it involves in its operation nearly all the principles of hydrodynamics. It may, therefore, be brought within the domain of mathematics as well as any other machine.

In the attempt to calculate the power of the human heart for a given time, we shall arrive at some curious and interesting, not to say astonishing results. Few would credit, at first, the statement that the hearts now beating in and around the city of New York, exert an aggregate power ample to propel a large steamer across the Atlantic ocean at a fair rate of speed, yet we shall be able to demonstrate that this is as much a fact, as that any of these steamers ever crossed that storm-torn sea.

Blood is heavier than water; its specific gravity being, according to Booth, of from 1·0527 to 1·057. For convenience, however, we shall consider it as being of the same weight as water, extreme accuracy not being essential to our purpose and in our computations we shall, for the most part and for the same reason, throw out fractions and use round numbers.

The pressure required at the mouth of the aorta to force the blood through the vessels of the human body, is estimated by Hales, as being equal per square inch of surface, to