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Contents:

(Illustrations are indicated by an asterisk.)

ECONOMY OF FUEL.

There are two branches to this important subject; the first is the complete combustion of the fuel, so as to generate all of the heat possible; and the second is to transfer the heat thus generated from the hot gases which are the products of combustion to the water or other substance to be heated.

The condition necessary to effect perfect combustion is a temperature of about 1,000° above zero, and the contact at this temperature of each atom of hydrogen in the fuel with one atom of oxygen, and the contact of each atom of carbon with two atoms of oxygen.

Perhaps the best plan for realizing this condition yet reduced to practice is that employed in Roper's air engine. The fire is inclosed in an air-tight chamber, into which the air is forced by an air-pump, part below the grate and part above. The exit from this chamber is closed by a valve and opened at intervals, so that the air and the products of combustion are kept for some time mingled together in a close chamber where they are highly heated by the immediate presence of the fire. Under these circumstances it would seem hardly possible that a single atom of either hydrogen or carbon could escape without coming in contact with oxygen. Could not this method be applied to furnaces of steam boilers?

The plans for getting the heat out of the gases are yet very imperfect. A certain portion must be lost. It is of course impossible, even in theory, to obtain any more of this heat than the surplus above the temperature of the water in the boilers. In practice the gases go away at a temperature far above that of the water. While the temperature of the water ranges from 260° to 360°, that of the escaping smoke and gases in the chimney ranges probably between 600° and 1,000°.

As every pound of oxygen in the atmosphere is accompanied by 3½ pounds of nitrogen, which performs no part in the combustion, but which absorbs and carries away heat, there is a loss in the introduction of more air than is necessary to complete the combustion. The quantity of air requisite in theory would be that which should contain just enough oxygen to combine with all of the carbon to form carbonic acid, and with all of the hydrogen to form water. But if only this quantity were introduced, it is not probable that the substances could be so mixed as to bring each atom of the carbon and hydrogen in contact with the atoms of oxygen. In practice, therefore, it is necessary to carry in a surplus of air, but it is important that no more should be carried in than is sufficient to secure complete combustion. It will probably be found, also, that there is a proper proportion to be introduced below the grate.

No plan has yet been devised by which an engineer of ordinary intelligence can ascertain whether the products of combustion are wholly carbonic acid and water; that is to say, whether the combustion is complete. If our chemists could furnish some simple test of the presence of carbonic oxide, and of the hydro-carbons in the chimney, they would make a valuable contribution towards the perfection of the steam engine.

THE STEAM CAR ON THE SECOND AVENUE RAILROAD.

For a long time we have been hoping to see some movement of the city railway officials to introduce steam upon some portion of their lines instead of horses. This has been done at last, and it is owing to the energy and sagacity of Mr. E. S. Dickinson, the superintendent of the Second-avenue road. From 41st street to Harlem the company now run a car propelled by steam, not a "dummy," however, as it is absurdly called, for the steam exhausts into the smoke-pipe as does every locomotive. This is an experiment that we hope will succeed, and with the practical knowledge, judgment and good management of the superintendent, we do not see how it can fail.

The cost of running is the principal point in the substitution of steam for horse-power. All other objections, such as frightening horses, etc., are foolish and unworthy of notice. The expense of running is favorable to the steam cars, for in ordinary times a horse car cannot be run for less than $8 per day, while the former costs but $6. We have not counted the cost now in the deranged condition of the currency.

Distant readers may be pleased to know some of the details of this car. It is 22 feet long in the clear —4 feet being allowed for the engine and boiler; the width is 8 feet and it will seat thirty-three persons. The work inside is extremely neat and chaste, and the car itself was built by the Second-avenue Railroad Company.

The engines are two in number, connected at right angles and set at an angle with the platform. They have inverted cylinders, or the same as an ordinary stationary engine set up on end with the cylinder at top, and have pistons 5½ inches diameter by 12 inches stroke. They are geared to work on the forward axle of the car, and together with the spur wheel weigh 1,000 pounds. They have link motion, and are neat and creditable specimens of workmanship. The boiler sets on one side of the platform and the engine on the other; the former is about the hight of a man's head and has about fifty 1½-inch tubes. It makes ample steam to heat the feed water, which is contained under the seats inside the car, and also to warm it if necessary in winter. Coal is carried back of the engines in a little bunker not bigger than a common trunk, and the amount is sufficient to run ten miles. In addition to the feed pump there is also a Giffard injector supplied. The engine and the machinery were constructed by Messrs. Grice & Long, of Philadelphia, who have already made a large number of their machines, and we are glad to see that the Second-avenue road is giving them a trial. If they prove as successful on this line as they have on others, there will be a very great reform in operating city railroads. Besides running themselves, these cars can take an additional one behind and ascend a grade of over 200 feet in the mile, with ease.

MINES IN WARFARE.

The recent experiments in exploding mines before the besieged city of Petersburg have, as is well known by this time, proved unsuccessful. One attempt was made by our own forces, and the other by the rebels. So far as the mechanical success is concerned the mines were certainly effective, large portions of the rebel works being blown (as one active and precise statistician records) 300 feet in the air—doubtless a very great point gained. There is one requisite, however, which seems to have been overlooked in both cases, and upon that rests the failure of the two attempts; this is the necessity for an immediate and ferocious assault by overwhelming forces upon the surprised foe, as soon as the opening was made. Exploding a tun or so of gunpowder in a shaft or tunnel of a certain size is as sure to upheave the superincumbent portion as an earthquake, but powder without promptness is of little use; and when the deadly breach is made, it requires presence of mind and military genius to gain the desired point.

We may rest assured that mining in this way will do us but little good, and the enemy no harm whatever, *per contra,* it appears in the late assault that we suffered the most and that our mine was only a snare in which thousands of our men were slaughtered. While we mine the enemy countermines; the game is one that two can play at, but the force which adds energy in assault to the surprise gained by the sudden destruction of the enemy's defenses cannot fail of a substantial reward.

CONCERNING BOILER EXPLOSIONS.

In commenting upon these disasters we have endeavored to account for them from strictly legitimate and practical conclusions, and have deprecated the attempts which are made to give the subject a false issue by throwing the blame upon some mysterious gas, some theory more intricate and curious than sensible, or some other cause quite as far from the true one. We are not so dogmatic or downright in our assertions as to say positively that from one cause and no other boilers will inevitably explode; but this we say—and it is the fact in three-fourths of all the explosions which occur—that more accidents in the use of steam occur from positive neglect, or its equivalent, than from anything else. In the case of the Martin boiler which exploded on the *Chenango,* one witness occupied many hours in an attempt to prove that the disaster was wholly due to the presence of highly superheated steam in the boiler which suddenly converted the remaining water into steam of a dangerous pressure on opening the throttle valve. No sooner is some elaborate theory propounded than the results of practice utterly neutralize it, and the sophism of it is clearly shown. The experience of those in charge of the *Golden City,* one of the Pacific Mail Steamship Company's ships, is a case in point. This vessel has Martin boilers, and on her very first trip down the coast, on her way to California, the water got low, the tops of the arches were heated red hot, and were forced down by steam pressure, but no explosion followed; and the ship returned to port, was repaired, and is now doing good service on her route. Now if we assert that boiler explosions are due to obscure and not natural causes, it is but reasonable to assume that superheated steam in this instance—for there is no doubt of its existence—would have caused as much damage as in any other. Not only in this but in every other boiler where it is generated. In every upright tubular boiler there is always more or less of it, at a greater or less degree of temperature, and if it is dangerous in one cause it certainly will be in another.

Boilers are now building in this city, not upon Martin's plans, however, for a United States steamer, which have superheating chambers in the upper part, so that the heated gases from the furnaces pass through tubes in the steam chamber. If superheated steam is a source of danger, these boilers are infernal machines that should never be allowed to pass inspection.

THE CURRENCY QUESTION.

"The greatest care will, however, be requisite to prevent the degradation of such issues into an irredeemable paper currency, than which no more certainly fatal expedient for impoverishing the masses and discrediting the Government of any country can well be devised."—SECRETARY CHASE.

The opinion extensively prevails that a further issue of Treasury notes will make money more plenty, and will thus increase the ability of the people to supply Government with the means of carrying on the war. We have no doubt that this opinion is unsound, and we think the mistake results from confounding money with capital.

In November 1861, the Secretary of the Treasury stated the bank circulation of the loyal States at 130 millions of dollars, and the specie in circulation could not have exceeded 70 millions, making the money of the country 200 millions. By the census of 1860 the wealth of the loyal States is returned at 10,716 millions of dollars. So that the money of the country was less than two per cent of the property of the country.

If there had been no property in the country but 200 millions of money, no issue of Treasury notes, and no other contrivance, would have enabled the Government to support the war for a single season. What is requisite for carrying on the war is a supply of beef, flour, horses, wagons, coffee, gunpowder, harnesses, iron, timber, and the various other forms of property which are required in naval and military operations. The capital of the country is made up of these things; the money, as we have shown, amounting to only two per cent of the whole. When capitalists make a loan to the Government, money is temporarily used to effect the exchange, but the final transaction that really takes place is a transfer of flour, beef, or some other kind of merchandise from the possession of the capitalist to that of the Government.

When one man has a debt due him from another, it is generally an error of speech to say that he has money at interest. In most cases the debtor has but a small proportion of the amount of his debt in money; but, if the debt is good he has the whole amount in some other kind of property. If the debtor sells his wheat and oxen to the Government and pays his debt, and the creditor invests the amount in Government bonds, a portion of the capital of the country is consumed in military operations, while the money in the country remains just the same as it was before. All the use of the money in the transaction was to facilitate the exchange of the property; enabling each man to exchange a given value in the property which he had for an equivalent value in the kind of property that he wanted. And this is the only use of money in human affairs. Wealth, property, capital, in its various forms, has innumerable uses, but money has only this one use. It is a convenient instrument to employ in making exchanges of property.

When a capitalist has loaned his property to the Government, the only way that he can make a furtner loan is by accumulating more property. Ask any individual capitalist how the issuing of more Treasury notes is going to increase the amount of capital that he has to invest in Government bonds.

THE HECKER AND WATERMAN EXPERIMENTS.

We give this week the results of Mr. Waterman's calculations of the quantity of steam condensed in doing the work that was done. Mr. Joule ascertained that the quantity of heat which will raise the temperature of one pound of water one degree, is just sufficient, if expended in mechanical work, to raise 772 pounds of matter one foot high. This quantity of heat is called a unit. It is found that whenever heat is employed to produce mechanical effect, for every 772 foot-pounds of work done one unit of heat is destroyed. When a portion of the heat in saturated steam is destroyed, a corresponding portion of the steam must be condensed. As the quantity of heat required to evaporate water at given temperatures is known, if the quantity of heat destroyed can be ascertained it is easy to calculate what portion of steam would be condensed in consequence.

Mr. Waterman computes the work performed by the engine by multiplying the mean pressure on the piston into the length of stroke. He then calculates how many units of heat this amount of work would consume, taking 772 foot-pounds to each unit. We accompany the figures with such of those already published as have a bearing on this branch of the subject.

The series tried from May 17th to May 27th; engine worked as a condenser, without steam in the jacket.

Pounds of feed-water pumped into boiler from tack—

7/8ths cut-off	16,622
2/3ds cut-off	14,981
1/2 cut-off	14,568
1/4th cut-off	12,826

Pounds of steam in cylinder at end of stroke—

7/8ths cut-off	10,359
2/3ds cut-off	8,334
1/2 cut-off	7,912
1/4th out-off	6,313

Percentum of steam condensed in cylinder—

7/8ths cut-off	37·8
2/3ds cut-off	44·3
1/2 cut-off	45·7
1/4th cut-off	49·2

Pounds of steam condensed by doing work, computed from Joule's equivalent—

7/8ths cut-off	943·37
2/3ds cut-off	933·46
1/2 cut off	972·09
1/4th cut-off	1117·12

Percentum of steam of the whole quantity evaporated condensed by doing work—

7/8ths cut-off	5·73
2/3ds cut-off	6·24
1/2 cut-off	6·68
1/4ths cut-off	8·71

The series tried from May 12th to June 4th; engine worked as a condenser, steam in jacket.

Pounds of feed-water pumped into boiler from tank—

7/8ths cut-off	12,901
2/3ds cut-off	11,267
1/2 cut-off	11,188
1/4th cut-off	9,632

Percentum of steam condensed in cylinder—

7/8ths cut-off	15·4
2/3ds cut-off	21·3
1/2 cut-off	28·4
1/4th cut-off	10·4

Pounds of steam condensed by doing work, computed from Joule's equivalent—

7/8ths cut-off	913·25
2/3ds cut-off	875·9
1/2 cut-off	929·67
1/4th cut-off	876·19

Percentum of steam of the whole quantity evaporated, condensed by doing work—

7/8ths cut-off	7·01
2/3ds cut-off	7·78
1/2 cut-off	8·22
1/4th cut-off	9·32

The series tried from April 1st to April 26th; the engine worked as a non-condenser, steam in jacket.

Pounds of water pumped into boiler from tank —

7/8ths cut-off	15,571
2/3ds cut-off	13,056
1/2 cut-off	12,604
1/4th cut-off	10,394

Percentum of steam condensed in cylinder—

7/8ths cut-off	11·3
2/3ds cut-off	11·3
1/2 cut off	7·9
1/4th cut-off	9·7

Pounds of steam condensed by doing work, computed from Joule's equivalent—

7/8ths cut-off	1470·76
2/3ds cut-off	1514·60
1/2 cut-off	1335·2
1/4th cut-off	1140·37

Pounds of steam of the whole quantity evaporated, condensed by doing work—

7/8ths cut-off	9·45
2/3ds cut-off	11·61
1/2 cut-off	10 6
1/4th cut-off	10·98

These calculations and their results are interesting. Regnault's experiments led him to the conclusion that the power of a steam engine is in proportion to the heat lost by the steam in the part of the engine performing the work. To obtain, therefore, the whole power of the heat, it would be necessary to perform work enough to condense all of the steam; and if only sufficient work is done to condense 10 per cent of the steam, it follows that only one-tenth of the power of the heat is obtained. It will be seen that in these experiments the work was sufficient to condense from $5\frac{3}{4}$ths to $11\frac{2}{3}$rds per cent of the steam. The facts will doubtless suggest also many other points for reflection to intelligent engineers.

As statements, however, of the actual condensation of steam in the cylinder by the destruction of heat in doing work, we do not consider them as reliable. While the steam port is open the expansion takes place in the boiler as well as in the cylinder, and the heat destroyed in the boiler is renewed from the furnace. There are so many ways, too, in which work may be done, such as disturbing the atmosphere, in friction of the steam against the walls of the passages, and other modes, that we should consider an ordinary steam engine as a clumsy apparatus for measuring it. We have confidence in the correctness of the calculations, they have been made from approved formulas, and have been carefully checked.

THE NEW LAW FOR MEASURING SHIPS.

The law heretofore in force in this country for measuring ships was very defective, as we have repeatedly pointed out. But three dimensions were taken, one of length, one of breadth, and one of depth, so that the vessel's tunnage was ascertained with no reference to its lines, and with very distant approach to accuracy. It always gave the tunnage much greater than it really was. At its last session Congress passed a new law for the measurement of vessels, which will make the measures much more accurate than those by the old method. But the rules established by the new law are exceedingly complicated and clumsy, and they do not give accurate results.

An approximate estimate is made of the cubic contents of the vessel below the deck in feet, and each 100 cubic feet is called a tun.

The directions for ascertaining the cubic contents of a large vessel (over 250 feet in length) are to divide the length into 16 equal parts, and to measure the area of the cross section at each division. To get the area of the cross section the depth is divided into four equal parts, and the breadth measured at each division, as well as at the top and bottom, making five measurements of breadth at each transverse section. Commencing at the top, the second and fourth breadths are multipled by four, and the third by two, the products are added together, and to them are added the first breadth and last. The sum is multiplied by one-third of the common difference between the breadth, and the product—whatever it may be in mathematics—is pronounced in law the transverse area.

Then from the several areas the cubic contents are obtained by a process not less round-about, and equally inaccurate. For smaller vessels the process is the same except that fewer cross sections are measured. It seems to us plain that it would be much easier to teach any person to compute the contents of a vessel with perfect accuracy by dividing the portions between the several cross sections into regular geometric figures, prisms, wedges, and pyramids, as is done in computing earthwork, than it would to teach this complicated and inaccurate rule. A simple enactment that the tunnage of a vessel should be ascertained by dividing the cubic contents below the deck in feet, by 100, would express the intention of Congress with more precision than these clumsy rules, and there would be no difficulty in understanding the law.

A Trip in a Fire Balloon.

M. Eugene Godard, with five companions, made an ascent from Cremorne Gardens, in London, on the 20th July, in an enormous balloon of his own construction, which he styles "The Eagle." In this machine M. Godard discards gas, and goes back to the ordinary original Montgolfier balloon, which is commonly known as a "fire balloon." It is 117 feet 7 inches in hight, 95 feet 9 inches in circumference, 300 feet 6 inches superficial, 30,000 feet in area, 2,005 lbs. in weight, 498,556 cubic contents.

In the center of the car is an 18 feet stove, including the chimney, 980 pounds in weight; three cylinders, three inches apart from each other, invented by M. Godard, with a view to counteract the effects of the radiated heat upon the occupants of the car. Inside the flue is a metal colander to intercept sparks. The combustible employed is rye straw, cleaned from the ears and compressed into blocks. The total weight of the balloon (including the grappling-iron cords, 400 lbs. two supplementary pumps, 150 lbs., and combustible 500 lbs.) is 4,620 lbs. The inflation only took forty-five minutes; and M. Godard says that, under favorable circumstances he can fill and start in less than half an hour.

At a quarter to 8 the whole fabric stood up amongst the trees and poles of the ground, and the various ropes that held it to the earth were cut away one by one. M. Godard ran rapidly round the solid wicker car, shouting orders through a speaking trumpet with pardonable excitability. One of M. Godard's companions gives the following account of the voyage:—

"Let the reader imagine that he has been riding in the engine of an express train; let him then conceive that this engine, with the fire roaring in the furnace, has suddenly leaped into the air, and he will get some faint notion of the situation.

"There was not much wind, and the balloon, slowly rising, took its course to the south-eastward of London. At times it seemed becalmed, and during these intervals of quiet those who looked out over the panorama of London owned that the sight was well worth the risk. The red light glared out and was seen afar; the heat was almost painful, but neither amongst Englishmen nor Frenchmen was a murmur heard as steadily, one after one, the trusses of straw were passed into the fire. At no time did the balloon ascend much above half a mile, and at no time did that ugly roaring crackling clamor cease; but M. Godard was bland and brave; his fellow-countrymen were courteous and courageous, and the Englishmen held their tongues.

"At length, after crossing and re-crossing the river, it was determined to descend. Three times already had the balloon passed over the Thames, and when it was resolved to alight, M. Godard was over the Isle of Dogs. He had affixed his eye however, upon the East Greenwich marshes as an open space in which the descent could be safely attempted