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COLBURN ON BOILER EXPLOSIONS.

BOILERS and bottles have a much closer relationship than most persons would imagine. Of this fact, we have been powerfully convinced by a pamphlet (recently published in London), by Mr. Zerah Colburn, formerly of New York, but now of the London *Engineer*. It seems to have produced something like a bomb-shell explosion among the mechanical periodicals of the British metropolis, on account of a new theory advanced therein. This consists in attributing an explosion to the reduction, at first, of the pressure of ordinary steam in a boiler through a rupture, by means of which some extra escape of steam is effected. This lowering of the pressure, it is held, produces the disastrous result by a secondary effect, namely, the instantaneous flashing of a large quantity of the water into steam, thereby causing it to strike "a violent blow" against the shell. We have stated this theory in as few words as possible. Mr. D. K. Clark, the well-known writer on railroad subjects, has also advanced a theory on this question, which is given in the pamphlet in the form of a letter. It consists in attributing explosions to the sudden projection of water against the bounding surfaces of the boiler, and that the combined momenta of the water and steam act like shot to shatter the metal; simple over-pressure of steam not being sufficient to account for an explosion.

The London *Mechanics' Magazine* has criticized the pamphlet with considerable severity, and Mr. Colburn has replied in two letters, in one of which he takes the familiar example of a bottle of soda-water discharging its gas and fluid contents into the air to illustrate Clark's theory; and he maintains his own with decided ability. We shall give our reasons to show that it is not *altogether* proved, however; and, as for Mr. Clark, he simply mistakes an effect for a cause. All explosions of boilers or bottles are due entirely to the over-pressure of expansive gas or vapor, not the percussion of the fluid.

Mr. Colburn's theory assumes that, when the pressure of steam is suddenly lowered, a *greater quantity* of water in the boiler than that due to supply the reduced pressure caused by the escaped steam, is instantly converted into steam; thus causing a vast and sudden over-pressure, which shatters the metal to fragments. If equal effects are produced from equal causes, we do not see how this can be possible. If steam of 60 lbs. pressure in a boiler is suddenly reduced to 50 lbs. pressure—from a temperature of 294.1° to 281.3°—by escaping through a rupture, the quantity of water converted into steam will neither be more nor less than the amount required to raise the pressure to 60 lbs.; and so on for all other pressures, and the excess will be immediately carried off through the rupture. Safety-valves are applied to steam boilers because this principle is held to be correct; but if Mr. Colburn's theory is true, safety-valves are the most dangerous appliances that have ever been attached to boilers, and the whole engineering profession, from the days of Papin to the present moment, have been wofully blind to their true nature. If, as this theory assumes, an explosion is caused by the sudden escape of steam, a safety-valve is to a boiler what a percussion cap is to a loaded cannon. At the same time, however, this theory affords a very plausible explanation of some apparently mysterious explosions which have taken place. Thus, a boiler exploded, a few years ago, in Philadelphia, at the instant the engineer lifted the safety-valve, by which event he lost his life. A great number of explosions have also occurred just when the engine or pump had been set in motion, whereby the pressure had been first reduced in the boiler.

By this new theory, the incipient cause of every explosion is held to be a rupture in some weak part by over-pressure; and if, as a whole, it cannot be sustained, it can do no harm, but rather good, because it affords a most powerful support to those who attribute all explosions to over-pressure of steam—either gradually or suddenly accumulated. We quote the following extract from this pamphlet, and fully endorse its appropriate soundness:—"All our knowledge of boiler explosions goes to show that, however possible it may be to accumulate an excessive pressure within a boiler, the actual explosion results in the majority of cases from some defect, either visible on concealed, in the materials, workmanship or construction of the boiler. Probably not more than one per cent of all the steam boilers made ever explode at all; but the results of systematic inspection show that a far higher per centage of boilers are constantly in a condition inviting explosion, and from causes which a general examination would not only disclose, but of which it would also insure the removal." This is a strong argument for voluntary Boiler Inspection Associations, which we have recently recommended, and which we hope may soon be formed throughout the various sections of our country.

ALUMINUM.

The ore of this valuable metal is scattered in millions of tuns through all sections of the country, being more abundant and more accessible than any other metal. All granite rocks and all beds of clay are partly composed of it. Pure clay, or alumina, is simply the sesqui-oxyd of aluminum ($Al^2 O^3$), containing 24 lbs. of oxygen to 27 lbs. of the metal, and all that is necessary to give us unlimited supplies of this precious substance is a cheap mode of separating it from the oxygen. So rapid have been the improvements in the method of effecting this separation, that within about four years, the price of aluminum has been reduced from $250 to less than $9 per pound. If the price should be reduced sufficiently, this metal is destined to play a great part in the industrial arts, for by its lightness, strength, and incorruptibility in the air, it is admirably adapted to many uses. Even at the present price, it will no doubt replace silver to a considerable extent.

The *Revue Universelle*, from which we translate, describes two processes for the reduction of the sulphuret of aluminum, which have recently been patented in England by J. Johnson. The sulphuret is first obtained from the sesqui-oxyd by one of the known modes; for instance, by passing sulphureted carbon over alumina heated red-hot in a suitable apparatus. This sulphuret is placed in a furnace with such a proportion of the sulphate of alumina that the oxygen which is disengaged by the heat will produce sulphurous acid by combining with the sulphur of the substances employed. The furnace is sealed air-tight and raised to a high temperature, when the whole of the sulphur combines with the oxygen, forming sulphurous acid, and the aluminum is left in the metallic state. In the place of the sulphate of alumina, anhydrous alumina may be employed if care is taken to proportion the alumina to the sulphuret, so that the oxygen of the former may combine with the sulphur of the second, and carry it off in the form of sulphurous acid. It is well to aid the reaction by frequent stirring of the mixture. When the aluminum has been obtained, it may be treated in a manner similar to that in use for puddled iron, and is capable of being either hammered or rolled.

In Mr. Johnson's second process, the sulphuret of aluminum is placed in a melting pot, and sheltered from contact with the air. It is then heated red-hot, and submitted to the action of a current of dry hydrogen, which carries off the sulphur of the sulphuret in the form of sulphureted hydrogen. By adding the sulphuret of another metal, an alloy of the two metals is obtained. The hydrogen employed in this process may be economically obtained by passing the vapor of water over red-hot coke or charcoal.

Some of the alloys of aluminum have very remarkable properties, especially the aluminum bronze, composed of 90 lbs. of copper to 10 of aluminum. This alloy is stronger than the best wrought iron; it may be cast, hammered, or rolled, and it resists the corroding action of the atmosphere, nearly if not quite as well as gold. Besides these properties, it is of a beautiful yellow color, and is susceptible of a very fine polish.

Alloys of aluminum may be obtained by the decomposition of alumina by carbon, in contact with certain metals electro-positive in relation to aluminum—for instance, copper and iron. E. L. Benzon obtains an alloy of aluminum and copper by the following method. Alnmina, animal charcoal and copper (either the simple metal or the protoxyd or peroxyd), all finely pulverized, are thoroughly mixed together in proportion to their atomic weights, and placed in a melting pot similar to the pots in use for cast steel. The mixture, covered with charcoal, is exposed to a strong red heat, nearly sufficient to melt the copper, uutil the aluminum is reduced to the metallic state. The heat is then augmented for half an hour or an hour, until the metals are thoroughly melted together and a perfect alloy obtained.

THE AGE OF STEAM.

The eras of gold and silver and bronze no longer exist; with the lapse of centuries, and the progress of time, they and their barbarism have passed away, and a new age and period holds sway. *Steam*—the agent and servant of man—represents it; and to its influence and through its might the desert becomes populous, the wilderness smiles and is busy with the hum of a new generation, with new thoughts and strong purposes, who carve its very stones into habitations and shelters, and wrest from the bowels of the earth an abundant and a generous support.

If we take a stand in a mental point of view, and look backward upon the years which are irrecoverably gone; if we reflect through what convulsions and changes the political and social world has passed, from a state of ignorance and commercial stagnation to one of the most prosperous and peaceful, we must see among the most prominent and efficient causes of this reformation—steam. Without it, at this present day, if it were abolished and utterly unknown, on the face of the earth, darkness would reign again as it formerly did. The development of the arts and sciences in their highest perfection tend inevitably to moral and social advantage, if it be only in the insignificant cause of lessening the severity of labor through the use of a powerful motor; leaving more leisure for the workman and the operative to search out the causes which produce certain effects, and which lead him, as stated before, insensibly to the cultivation of a thoughtful mind; and the improvement and stimulation of the brain, within proper bounds, is the very base and foundation of a national and commercial greatness.

The rudest minds and the most unreflecting persons who are, by chance or necessarily, brought up to its use, cannot fail to wonder and feel awe-stricken, at times, in the presence of this awful force. Escaping from its bonds, and rending all before it, as it does sometimes through carelessness or mismanagement, it exemplifies in a literal sense, and demonstrates in a most practical manner, the strength of its sinews and the illimitable range of them. Who can form any accurate estimation of what power is exerted against the pistons and cranks of a steamer moving so majestically and surely in the teeth and front of the hurricane and tides, until, some parts having given out, it lays bent and twisted into a hundred fantastic shapes? Rods and links, six or eight inches in diameter, of the best wrought iron, bent at right angles as a boy would bend a wire; and iron castings, ribbed and strengthened with braces and radii, snapped into fragments as if they were but the frailest glass. When he sees all this, then may he form some conception of that noble servant who, at this moment as we write, is driving a thousand busy wheels and whirling heavy masses in mid-air, to the increase of wealth and the general prosperity. There is not a mechanical force in operation at the present day, nor a machine turning out work by the 100 per cent better and faster than by manual labor, but what owes its origin, in some form or other, to the power of steam. If we take the pick of the miner (who plies his calling in subterranean darkness, and who burrows like a mole), even so small