relation to the phenomena of catalysis as that of the ordinary batteries does to those of ordinary chemistry. Whether these effects could be produced by other inoxidable metals, (such as gold or silver,) is an experiment worth trying. The more we examine chemical and voltaic actions, the more closely do we assimilate them. For some mysterious reason, three elements seem necessary for very many, if not for all, chemical actions.

c. This battery is peculiar in having the current generated by gases, and by synthesis of an equal but opposite kind at both anode and cathode; it is, therefore, theoretically, more perfect than any other form, as the batteries at present known act by one affinity at the anode, and have to overcome another at the cathode.

d. This battery establishes that gases, in combining and acquiring a liquid form, evolve sufficient force to decompose a similar liquid, and cause it to acquire a gaseous form. This is, to my mind, the most interesting effect of the battery; it exhibits such a beautiful instance of the correlation of natural forces.

Many other notions crowd upon my mind, but I have occupied sufficient space, and must leave them for the present, hoping that other experimenters will think the subject worth pursuing.

Lond. & Edinb. Philos. Mag.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Facts and Observations on the Explosion of the Boiler of the Steamboat Medora. From a communication made by CHARLES REEDER, Engineer.

The Committee on Publications have received some further facts relative to this explosion, from Mr. Reeder, of Baltimore,—the engineer to whom was intrusted the repair of the machinery of the unfortunate Medora, after the fatal disaster which happened to her upon the 14th of April, 1842, and which has already been described in a memoir by B. H. Latrobe, Civil Engineer, inserted in our last November number.

Mr. Reeder cut from the cylinder part of the exploded boiler, several strips of the metal, and subjected them to experiment, with the view of determining the absolute strength of the iron of which that boiler was constructed.

The following tabular statement furnishes the results of these experiments; the sixth trial was upon a strip of No. 3 wrought iron boiler plate, from the manufactory of Brooks & Co., of Pennsylvania; the other five trials were all made upon the iron of the Medora's ruptured boiler.

Since the mean strength of wrought iron boiler plate is about 55,000 lbs. per square inch of section, it is evident from Mr. Reeder's experiments, as recorded in the subjoined table, that the iron of the Medora's boiler must have been *of an inferior quality*.

No. of the exper'ts.	Dimensions of the strip tried.		Area of section in sq. inch s.	Direction of strip in the sheet.	Weight which broke the strip in lbs.	Strength in lbs. pr sq. inch of sect'n	Remarks.
	Br'dth in inch.	Thick. in inch.					
1	.250	.237	.05925	across	1720	29029	broke in two minutes.
2	"	"	"	lengthwise	3040	51308	broke instantly.
3	"	"	"	"	2625	44304	do.
4	"	"	"	"	2420	40844	broke in three minutes.
5	"	"	"	"	2440	41181	do.
6	—	—	.06500	"	3780	58154	—

Mr. Reeder has furnished us with two sketches, (Figs. 1 and 2,) which we subjoin, as they exhibit more clearly the internal construction of the exploded boiler of the Medora, than those we have already published.

Fig. 1 is a transverse section of the boiler, in which *g* is the water line, above the return flues, and *h h* the places of the furnaces which heat the water.

Figure 2 is an isometrical sketch, showing the interior of the boiler, and the large openings communicating with the water legs.

Mr. Reeder states that the length of the boiler, between the back and front flue heads, was 198 inches; the apertures, or parts cut away to form the openings of communication with the water legs, 117 inches.

Hence the aggregate breadths of the strips *s, s*, Fig. 2, amounted to but 81 inches, measured in the direction of the length of the boiler; but even this breadth of metal was again reduced by the rivet holes, which were $1\frac{1}{2}$ inches from centre to centre, and 46 in number, each being $\frac{1}{16}$ ths of an inch in diameter; therefore $198 - (117 + 46 \times \frac{1}{16})$, or $198 - (117 + 31\frac{1}{4}) = 49\frac{1}{4}$ inches, the aggregate breadth of iron left, to resist the internal strain over the side water legs.

The ratio of the iron left, to the whole length of the boiler, is, consequently, $49\frac{1}{4} : 198$, or $1 : 4.08$; so that every 1.02 inches of the length of the boiler would require, from the average of the whole five experiments given above, a force of say 2449 lbs. to rend it asunder, or only about 2400 lbs. per lineal inch of one side.

But, taking the mean longitudinal strength of the strips from the boiler, tried by Mr. Reeder, and rejecting the first experiment, we have near 44,000 lbs. per square inch for the average strength of the iron.

Now, if, in the formula $x = \frac{2Pt}{D}$, where x represents the pressure per square inch, we assume, from Mr. Reeder's data,

$D = 132$ inches;

$P = 44,000$ lbs.;

$t = .237$ of an inch;

then we have $x = \frac{2 \times 44,000 \times .237}{132} = 158$ lbs. per square inch of steam

pressure, required to burst the Medora's boiler, if it were a continuous hollow cylinder, and the circumferential strength be alone regarded; but as the metal cut away over the side water legs amounted to $148\frac{6}{10}$ inches, out of 198 inches of the boiler's length, leaving, in fact, but $49\frac{4}{10}$ lineal inches of iron, $\frac{237}{1000}$ of an inch thick, to resist the circumferential pressure within, we have then the following proportion— $198 : 49\frac{4}{10} :: 158 : 39\frac{4}{10}$ lbs.

Therefore, from the data furnished by Mr. Reeder, it seems apparent that the maximum circumferential strain which the boiler of the Medora could have borne without bursting, *did not exceed* $39\frac{4}{10}$ lbs. per square inch!

With regard to the steam pressure which the fully loaded safety valve could fairly impose upon the boiler in question, Mr. Reeder states that the large weight, which our intelligent correspondent, Mr. Latrobe, estimated to weigh 200 lbs., did actually weigh 210 lbs.; and Mr. R. being of opinion that the pressure on a safety valve ought to be calculated only by the steam pressure upon its *lower* surface, he estimates the load of that safety valve thus:—266 lbs. of weights $\times$ 16.128 leverage = 4290.048; to which the weight of the valve, &c., &c., as estimated by Mr. Latrobe, (692 lbs.) being added, we have

$$\frac{4290.048 + 692}{182.7} = 27\frac{26}{100} \text{ lbs. pressure of steam per square inch, ne-}$$

cessary to raise the safety valve, if perfectly free of adherence to its seat.

Mr. Reeder expresses the opinion that the main defects of the Medora's boiler were, firstly, that too much metal was cut away over the water legs, (*a a*, Fig. 2,) without in any manner bracing the apertures, or substituting the strength so removed; secondly, that the inside sheets of the side legs were joined to the cylinder, (as at *b d*, Fig. 1,) *by being curved downwards*, instead of being continued vertically upwards to a junction; and, lastly, that the flues were so disposed as to prevent the insertion of braces from the top, to support the bottom of the cylinder.

Mr. Reeder further remarks, that the strips *s, s*, being 33 inches long, of the same curvature as the cylinder, and subject to be drawn upon both sides, in a straight direction, (*d, e*, Fig. 1,) by the steam pressure, formed, in fact, a series of springs, upon which the lower half of the boiler was hung, or supported, so that, when the full steam pressure was on, the several strips would be drawn nearly into right lines, and, when it was off, they would spring back, and recover their curvature—thus allowing the boiler to vary essentially, in its shape, whenever put into use. From the observations which he made, and which he had so good an opportunity of making, Mr. Reeder appears to think that the boiler of the Medora was, in all probability, injured, or weakened, in the two trials which were made with it, prior to the 14th of April; and he expresses the decided opinion, that 23 lbs. pressure per square inch *was enough* to produce, upon the last trial, the fatal explosion which at that date took place; and Mr. Reeder also expresses a belief that this boiler would have *eventually* failed, under a pressure not exceeding 15 lbs. to the square inch.

Mr. R. further observes, that the evidence “of John Watchman, (the builder of the Medora's engine and boiler,) who tried (unsuccessfully) to raise the safety valve, when the steam gauge showed ten inches of steam, might impress some persons with the belief of its being fastened down.”

“His mode of raising the valve was by a small cord attached to the end of the lever, and running over a small pulley directly above it, thence to a similar pulley, and finally down to a place convenient to the engineer.”

“Under a pressure of 10 lbs. by the gauge, if the weights were out to, or near, the end of the lever, a man would have to overcome a

weight of about 170 lbs., (in addition to the friction of those pulleys,) by pulling down upon the cord."

"Now, the reason that he could not lift the safety valve, was not because it was fastened down, but simply because, being of less weight himself, he was not able to overcome that which he had to lift."

We will now conclude this subject by remarking, that the mystery which, in the opinion of Mr. Latrobe, seemed to hang over the causes of the explosion of the *Medora's* boiler, appears to be wholly removed, or cleared up, by the information derived from Mr. Reeder; for, as the steam pressure imposed by the weighted valve amounted, at the least, to 27 lbs. per square inch, whilst the maximum strength of the boiler was only 39 lbs., or but little more than 40 per cent., over the clear circumferential strain, even if we leave the longitudinal stress out of view, there was evidently not sufficient surplus strength to compensate for the imperfections in materials and workmanship, which are inseparable from such constructions, *and which always render a wide margin necessary between the maximum strength and the maximum pressure*—a margin, which a just regard to safety absolutely requires to be such, that the original strength of a steam boiler shall be, at the least, equal to treble the pressure to be ever imposed.

It would therefore seem to be a safe conclusion, that, in seeking for the causes of the explosion of the steamer *Medora*, *we need not go beyond the insufficient strength and injudicious construction of the boiler, to find a sufficient reason.*

We learn that Mr. Reeder has reconstructed the boiler of this steamboat upon the same general outline, but he has carefully avoided its imperfections; thus, he has placed the flues in regular order above each other, so as to admit of the insertion of stay bars, or braces, both vertically and horizontally; and alongside of the openings into the water legs, which occupy, in the aggregate, much less space than in the old boiler, he has secured broad bars of iron, in such manner as to substitute, or, in effect, to replace, in point of strength, the sectional area of iron removed; finally, he has continued the inner sheets of the side water legs vertically upwards to join the cylinder, and has formed the connecting flanch *internally*.

With these judicious alterations, and the great additional strength thereby imparted to the boiler, the *Medora*, under the new name of the *Herald*, is now, and for some time has been, working safely and successfully in the Chesapeake Bay.

On the Blowpipe. By THEO. F. MOSS, *Mining Engineer.*

The importance of the Blowpipe in analytical research is daily advancing with the progress of chemistry. The knowledge of its use is of the utmost importance to the mineralogist, for with the assistance of a few simple re-agents, he is enabled to determine in a few minutes most of the compounds of a mineral, which by the usual