inch sufficient to burst the boiler; P strength of the iron = 50,000 lbs.; t the thickness = 0.24 inch; D the diameter of the boiler = 36 inches; and we have x = 666 lbs. per square inch; but as the method of constructing the boilers with rivets reduces this strength, we allow for the reduction, which gives the result of 456 lbs. per square inch, for the actual resistance of the boiler.

Your committee are well aware of the difficulty of arriving at an exact conclusion as to the value of this resistance from this data, as there may have been some parts of the boiler weaker than the strength given by the formula; and were there not other circumstances beside the simple explosion to guide them, they might have doubted that there was so great a pressure of steam. But the fact that, after diligent examination, no parts of the boiler were found to indicate weakness or wearing away of the plates more than has been allowed for in the formula; the discolored appearance of the fracture, indicating a heat not less than 400° Fahrenheit; the heated appearance of the plates themselves, the great distance to which some of the parts were thrown—all indicate a great and undue pressure of steam in this boiler.

We therefore conclude, that at the time the explosion took place, this boiler was subjected to an internal pressure of steam of not much if any less than 450 lbs. to the square inch, and a temperature of 457°; and that this extraordinary pressure was occasioned by an accumulation of steam, in consequence of the safety valves being hindered in their free action.

Whether this obstruction was occasioned by carelessness, or by some defect in the construction of the balances, your committee are unable to state, as they had no evidence which could be conclusive in the matter. But from comparison with other balances, said to have been similar, it was evident that a very little carelessness in screwing down the lever would render the safety valve useless; and this carelessness or inadvertency, your committee are of opinion, was the cause of this explosion. They would therefore suggest the adoption of the practical rule, that when the safety valves are loaded by means of a lever and spring balance, they should be so constructed as to render it impossible to screw down the balance beyond the limit of pressure fixed by the builder or the superintendent of the engines.

WM. P. PARROTT, }
SIMEON BORDEN, } *Committee.*

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Historical Anecdote of Robert Fulton. By M. ANDRÉ MICHAUX.

Communicated to the Society for the Encouragement of National Industry, by M. De Lasteyrie, at their meeting of February 2d, 1849.

[*Note.*—M. Michaux is the distinguished botanist sent to this country by the French Government, whose work upon the Forest Trees of America is still the standard work upon that subject.—*Ed. Journ. Fr. Inst.*]

“The friends of science and the arts take always a lively interest in inquiring into and learning of even the least circumstances connected with

great discoveries, especially with those which have exercised a remarkable influence upon the prosperity of nations generally.

"The employment of steam, applied first in manufactures, afterwards for the navigation of rivers, then upon the ocean, and finally upon railroads, may be considered as one of the most remarkable events in the nineteenth century.

"I propose to state one of the facts relative to this application, undertaken with the most entire success for the navigation of large rivers by Mr. Robert Fulton, which has most probably not been inserted in his biographical notice.

"Before the year 1806 I had already made two excursions to the United States of North America. On my return to France from my second voyage, I published an account of it under the title *Voyage à l'ouest des Monts Alleghany, &c.* In 1806, I undertook a third under the auspices of M. le Duc de Gaëte, then Minister of Finance.

"In this last journey, I was instructed to visit all the forests which then covered this part of North America. After having, with this intention, traversed in all directions the Southern, Central, and Western States, I directed my course to the Eastern. In this latter excursion I was accompanied by one of my friends, a French officer, M. Parmentier, a native of l'Orient, who had served in the army of General Moreau, to whom he was greatly attached.

"When we arrived at Burlington, on Lake Champlain, I determined not to prosecute my researches any farther, but to return to New York. We started, in consequence, in a pirogue for Saratoga, where we arrived three days after our departure from Burlington. From this town we went by land to Albany, situated on the North River, and distant about 160 miles from New York. The relations, commercial and other, of all kinds, between these cities are very many and very frequent. At this time decked sailing vessels arrived and departed every day with twenty-five or thirty passengers. The passage generally took thirty-six or forty-eight hours, according as the wind or tide were more or less favorable.

"We had been three days at Albany, when the arrival from New York of a vessel propelled by steam was announced. This boat, which was decked, was about 25 metres (82 feet) long, and was commanded by the inventor, Mr. Robert Fulton. Many of the inhabitants of the city and strangers who were there at the time went to visit it; every one made his remarks upon the advantages consequent upon this new means of navigation, but also upon the serious accidents which might result from the explosion of the boiler.

"The vessel was lying alongside the wharf; a placard announced its return to New York for the next day but one, the 20th August, and that it would take passengers at the same price as the sailing vessels,—three dollars.

"So great was the fear of the explosion of the boiler, that no one except my companion and myself dared to take passage in it for New York.

"We quitted Albany on the 20th August, in the presence of a great number of spectators.

"Chancellor Livingston, whom we supposed to be one of the promoters of this new way of navigating rivers, was the only stranger with us; he

quitted the boat in the afternoon to go to his country residence, which was upon the left bank of the river.

"From every point on the river whence the boat, announced by the smoke of its chimney, could be seen, we saw the inhabitants collect; they waved their handkerchiefs and hurraed for Fulton, whose passage they had probably noticed as he ascended the river.

"We arrived the next day between one and two o'clock at New York. We separated from Mr. Fulton after paying him the price of our passages.

"The day after our departure from Albany, and a few minutes after Chancellor Livingston had quitted us, Mr. Fulton expressed his surprise that, notwithstanding the number of persons who were going to New York, only two Frenchmen had had the courage to embark with him. In the course of the conversation, I informed him that M. Chaptal, then Minister of the Interior, had instructed me to examine the forests of this part of North America, and especially to study the trees which compose them, in reference to their employment in the useful arts. I told him that, on my return to Europe, I intended to publish a work upon this subject with plates. He approved of my project, adding that, in America, such a publication would be successful on account of its usefulness; that it would do me honor, and would be profitable to me; which has proved to be true.

"My companion and myself could not too warmly congratulate Mr. Fulton upon the complete success, not of his discovery, but of the application of steam to act thus powerfully against the wind and tide. With great kindness, he explained to us the mechanism of the machine, and how the impulse was given; he dwelt principally upon the incalculable advantages of this means for ascending the great rivers of the interior, particularly the Mississippi, navigable for a distance of more than 800 leagues, and of which the current has an extreme force and velocity.

"Upon my observing to him the difficulty which he would have to procure coal to heat his boiler, he said that he would replace it by wood; that the banks of the river were almost uninterruptedly covered with thick forests; that, in truth, this mode of heating would have the inconvenience of multiplying the stoppages, and increasing their length by the time necessary to fell the trees, cut them into proper lengths, and carry them on board of the vessel, etc. Do not, said I to him, let that disturb you at all. Last year, I crossed in several points the western parts of Virginia and Pennsylvania, situated between the Allegheny Mountains and the Ohio. The numerous and deep ravines cut by the streams which empty into that river exposed beds of bituminous coal, which lie at a depth of only two or three feet. This combustible is so easily procured that, although the whole country is covered with primitive forests, and consequently wood costs only the trouble of cutting the trees, the inhabitants (then it is true not numerous) found it more easy and less troublesome to go and get coal with a pickaxe and wheelbarrow; in short, that the abundance of this combustible, and the extreme ease of getting it were such, that it could be delivered at New Orleans, although the distance might be estimated at 800 leagues, at 10 francs per quintal. (\$2 per cwt.) 'Your information,' said Mr. Fulton, 'is one of the most agreeable facts which I could hear; there can be no doubt of the incalculable advantages of the application of steam navigation to the interior of the United States; you.,

gentlemen, are the first persons who have dared to accompany me, and who are witnesses of the complete success obtained.'

"It appears that, at this time, Mr. Robert Fulton did not suspect that steam navigation might be one day applied upon the sea, and for traversing the ocean in much less time than with sailing vessels; he said nothing to us about it. I informed Mr. Fulton that I intended to return to France about the end of that year (1807). He then said that he had but lately returned thence; that, under his deep conviction of the importance of this application of steam to navigation, he had presented himself to the Ministers of the Navy and of War, that they might give him the means of making experiments, and finally to the Academy of Sciences of the Institute; that everywhere he had been well received, but that the first answer to him was always the want of money; that moreover the expansive force of steam was a thing long known, and that, as to the application which he proposed to make of it to navigation, its success was very doubtful, because very probably this force, powerful as it was, would not succeed in overcoming, at certain seasons of the year, the violence of the currents of rivers. This opinion was also expressed in a report made upon the subject to the Academy of Sciences, by the Minister of the Navy, Decrès. Rejected everywhere, Mr. Fulton returned to America. 'During my solicitations of the Ministers,' said he, 'I went to see M. Carnot. If, said he, I had still the honor to be Minister of War, I would not hesitate a moment to give you the means to make your experiment, the success of which is unquestionable, for I understand all the means of its action, and I foresee the immense results for the future. Since you are about to return to France,' added Mr. R. Fulton, 'have the goodness to call upon M. Carnot for me, and tell him that I shall never forget the kind reception which he gave me; tell him of the complete success of my efforts and my perseverance, of which you are the first witnesses; tell him that I shall always feel the deepest regret that France did not profit by my offers for the great enterprize which her government then meditated.'

"If we refer to this epoch, we find that the Emperor had resolved to make a descent upon England, and for that purpose had collected together an immense army at Boulogne, and had, to effect his debarcation, built a great number of vessels of all sizes. If, then, M. Carnot had still been Minister of War, and twenty steamboats had been constructed in a few months by Mr. Fulton, what might we not augur for the success of the enterprize? Then, without question, would France have become the first nation of the globe. Her power would have been lasting, for it would have had for its base the products of her agriculture, and not manufacturing industry, whose prosperity is always subject to events."

Bul. Soc. Enc. Nat. Ind. Sept. 1848.

On the Diurnal Variations of the Magnetic Needle, and the Aurora Borealis.

By M. AUGUSTE DE LA RIVE.

Extract of a Letter to M. ARAGO. Translated for the Journal of the Franklin Institute, from *Annales de Chimie et de Physique*, 3me serie, tom. xxv., p. 310.

Permit me to communicate to you, with the request that you will submit it to the Academy of Sciences, an extract from a memoir which I