from the danger, or remove the dreaded boiler from the crowd which surrounds it, and from the possibility of deluging men, women and children, in boiling water—in boiling brine—in an atmosphere of over heated steam, or of destroying them by the fragments, or by the entire boiler, projected among their crowded ranks. *The boat which is first ascertained to afford absolute security will be a fortune to its proprietors.*

On the Safety of Steam Boats. By JOHN L. SULLIVAN, Civil Engineer.

Theodore Dwight, Esq.—SIR,—Your paper, and others, having given expression to the public solicitude on occasion of the late accident on board the *Marshall*, in reference to the future safety of passengers, it may be presumed that any suggestions to that end will be acceptable to a community with whom the inquiry may well arise, whether there can be any sure remedy for this danger?

To mention only some of its sources will enable all to answer the question for themselves.

The engineer (commonly so called) is not perhaps the person to whose negligence these calamities are chargeable, but rather to the fireman; who, besides throwing in the fuel, has to see, by the gauge cocks, that the water is kept adequately supplied. This station is extremely arduous, and he is to an unusual degree exposed to the temptation of drinking inordinately. The boiler is usually made of large diameter, and with an inside flue, which is intended to be always covered by the water. This is not the strongest form in which a boiler can be made, but is that which takes up the least room. This flue may, not only from the inattention of the fireman, but from any accidental obstruction or disorder of the supply pump, get uncovered, or the water low, when it will become red hot, soft, flexible, thin, and weak; and as this part of the boiler is out of sight, this may happen (to a degree short of giving way) frequently in the course of a season: and although the proper quantity of water may be presently regained, still the hidden weakness thus caused remains, and may show itself fatally at some subsequent period. If it were asked, how is the thickness of a boiler in all its parts, after being some length of time in use, ascertained to be sufficient? The usual method is to strike it with a hammer, wherever accessible, trusting to the indications given by the sound of the blow. In the making of boilers, it is possible that the plates may have flaws not quite obvious enough for their rejection, and it is not uncommon for rivets to break by the expansion of the metal, if not made of very good iron. Boilers may be kept in use too long, when the business is not very profitable. It is an expensive job to displace them for repairs, and it is natural to defer it as long as may be safe. Steam boats are sometimes sold at auction, to close a concern, when although the age of the boiler may be told, its condition cannot be so easily known.

It is commonly supposed that the safety valve is an effectual safe-

guard; and it is so, in a well made and well managed engine. The intention of it is to allow the steam to vent itself when it gets so strong as to lift the weight hung upon the lever of the valve. But it has been known to be fatally overloaded. Besides it is not calculated to give passage to a great and sudden increase of steam. And such sudden and great increase may happen when the flue has been long enough bare to get red hot, and water is suddenly restored in sufficient quantity to receive its accumulated heat. It is well known that water boils at 212° of Fahrenheit. But it is not so generally known that after this degree of heat, every additional 30 degrees, doubles and redoubles the expansive force of the steam, and that it requires very much less fuel and time to produce this 30 degrees more heat, than to produce the preceding 212° .

As explosions have not been confined to high pressure engines, and as the effects have been so tremendous, it has been supposed that the red hot iron of the flue must sometimes decompose a portion of water into its constituent gases, (hydrogen and oxygen.) But it does not seem to be necessary to resort to this supposition to account for the effects, if we consider the amount of the force suddenly liberated by the disruption of the boiler. It must be equal to the outward pressure on a square inch of the safety valve, perhaps never less than 20 lbs., multiplied by every square inch of the internal surface. The displacement of the boiler with such surprising violence may be accounted for from the recoil or reaction of the force from the first considerable resistance it meets with; as well as by the expansive force in the direction it takes. Thus when the Hoboken boat exploded, I am told the boiler was thrown upwards—the rupture being at the under side. That of the Helen McGregor being towards the stern, the boiler went overboard through the bow of the boat. Had the forward end burst, it might have been thrown as far as the cabin. The boat may be so injured as to immediately sink—the force driving some part of the machine through the bottom or side; or the shock may start the planking. In two instances the boat has sunk. The danger of this must be greater when the boilers are below, than when on deck.

Every one will admit that it will be for the interest of owners, masters, and men, to take the utmost care. But the danger is inherent in the nature of the power, and it is greater than that from negligence. One fact alone proves this: that the safety valve has not been a sufficient protection in either of the melancholy instances of explosion that have taken place. What is the inference? It must be that the boiler, though up to that time strong, has some how become too weak to bear an expansive force below what it was intended to contain; or else that somehow that force has become suddenly so great that the safety valve cannot give vent to the steam.

If then there can be no perfect assurance of safety in steam boats, and so far as depends on fidelity and judgment, much confidence must be reposed in individual labourers, there can be no safety but in keeping out of the reach of the explosion, should it happen; but this can hardly be done, if in the same boat. My opinion, long since formed, and the occurrence of so many accidents—the increase of

travel, and the number of steam boats employed, and the circumstance of their growing old, like other machines and vessels, prompt me to remind you of your being, some years ago, on an arbitration between the late Mr. Fulton and myself, to settle the question which of us had first originated the improvement in steam navigation, of separating the load from the power—the passengers from the danger. Had the award been in his favour, this method would probably have been then carried into practice; but being in mine, the exclusive privilege granted by the state to the North River Company, prevented. Yet I have the satisfaction of knowing it had the approbation of that distinguished leader in the art of steam navigation, and I now with pleasure see it in successful use for commercial transportation on the Hudson. But the attempt to carry it into effect for passengers, made with the steam boat Commerce, two years ago, was too feeble; she having no more power than is usual in boats of her class for their own impulsion.

The original design was to appropriate and devote the *leading* boat to the power, and to employ more than is usual for one boat; ample room on board permitting this conveniently, and of using the strongest form of boiler. The *follower* is attached to the leading boat, at a suitable distance, and in a manner that allows of steady motion; and being of a light, sharp construction, with one deck, the resistance of the water and air will be but small; indeed, it is the most favourable plan for great speed. It is yoking the gigantic powers of steam to a floating car, and driving them fearlessly along the liquid plain. There is also economy in this plan of operation. Fuel is the heaviest item of expense. The use of *anthracite coal* in steam engines, is a desirable improvement in their management. Hitherto, the difficulty was in augmenting and diminishing this kind of fire at pleasure, in boats. It required a peculiar form of furnace. I mention it because it will afford a sufficient degree of protection against excessive competition, should the state of public feeling positively require, in future, this perfectly safe conveyance.

It is not probable that the memory of the late accidents will pass away, as others have, with only a transient impression of their horrors. The danger has at length come near. Every boat to and from this city bears the connexions and friends of some of us. Were it simply a question of benevolence, or of some public improvement, it would be carried by acclamation. But there is one difficulty in the way. It is *considered a branch of business*, in which the public has no more concern than in stages. It is left to the enterprising in its line, and all trust that competition will produce perfection, as well as cheapness. And it might be left to ordinary competition, were it not a question of life. It is, in this respect, quite different from all other branches of business. It is a concern belonging to the public, as well as to the owners of the boats, and yet its defects and dangers are not of a nature to be prevented or guarded against by any law. Nothing but a determination of the community to have and sustain safe steam conveyance, will avail.

This branch of enterprise has taken the form of rivalry, in splendour and rapidity, and these admirable qualities will still command

an ample share of business. But, however admirable, they do not compensate for the risk of life. Why should not the public be also entirely satisfied on this point, and have the choice, at least, of safety. This improvement remains to be made, and superadded. Knowing its practicability, and the excellent accommodation of which this method is capable, it seems incumbent, at this time, thus to bring it into view. If its suggestion meets with approbation, a company may, perhaps, be formed, with sufficient capital for two equipments, one to proceed every day from New York to Albany. The passage may in this manner be accomplished, it is thought, in ten hours.

As travel is always increasing between these cities, and as a rational preference would be given to a commodious yotte, (yacht) drawn swiftly and steadily along, there seems to be some reason to expect the concern would be profitable. But the prevailing opinion may be, that it cannot be said to be certainly an object of speculation, or a source of profit. Perhaps the undertaking must rest alone on the basis of philanthropy and public spirit. If, then, on this ground, the prevailing sentiment of the community is favourable, perhaps it will be manifested by an ample capital, subscribed in moderate sums, especially should it meet the approbation of those who assemble daily at the banks and public offices, and to administer the city government. It is a measure of self-defence.

Submitting the subject thus to you, sir, for a place in your paper, I am, very respectfully, your humble servant,

JOHN L. SULLIVAN, Civil Engineer.

Patterson, N. J. 29th April, 1830.

[*Silliman's Journal.*]

Strength of Wine and other Bottles.

M. COLLARDEAU has constructed a machine for the purpose of trying the strength of wine bottles. It has been presented to the Académie des Sciences, and reported upon by MM. Hachette and D'Arcet. The bottle to be tried is held at the neck by means of a lever, having three branches, which grasp it below the ring; being then filled with water, it is connected by means of pipes, with a forcing pump, the pipe having a cap furnished with leather, which is firmly held down by the apparatus upon the mouth of the bottle; the pressure upon the parts here increases with the pressure of the water within the bottle. Besides the pump, levers, and connecting pipe, there is also a manometer connected with the interior of the bottle to show the pressure exerted. When a bottle is burst in this way by the hydraulic press, no violent dispersion of its parts takes place, unless, indeed, in place of being *filled* with water, a portion of air is left in; then when it breaks it flies to pieces, and would cause danger if exposed.

Bottles intended for the manufacture of brisk Champagne or Burgundy, being tried, were found to break with a force between 12 and 15 atmospheres, exerted from within, outwards; a few rose to 18 atmospheres. Bottles which had contained Champagne of the