have done so little to apply the stronger material to the principal members of a freight car. . . . We believe that the subject needs to be agitated, and that railroad companies would be the gainers by extended investigation and discussions on the subject of metallic under framing." *The Railway Age and Northwestern Railroader* says: "The tendency toward the use of metal is seen in car framing, and while not particularly exemplified in practice, is still strongly revealed in the current opinion and talk of some of our best mechanical officers . . . the car made in its practical entirety of steel is to-day considered as well within the range of probabilities for the comparatively near future." *The Railroad Gazette*, in an editorial of June 9, 1893, says: "What is most needed to gain the least cost of carriage per ton mile is a set of standard metal frame freight cars with uniform trucks. . . . If some of our progressive roads would take up this matter, and build perhaps 1,000 cars with steel under frames, or at least steel center sills, and do the work in the same thorough way that bridge work is done, there would be within five years' time some practical knowledge of real value that would bear upon the subject and be a safe guide for the future."

At the last convention of the Master Car-Builders' Association the following sentence appeared in the report of their committees: "When metal sills come into use it might be possible, on account of the changes which will be necessary in the draft-gears of most companies, to arrive at a standard. . . . We believe the time for the substitution of metal sills is approaching." We know that in some foreign countries steel under frames have been successfully used for many years, and in response to my inquiries the President of the German Railroad Commission writes in reference to steel frames for cars: "Such a construction is unchangeable, and is stiffer than that of wood, besides being perfectly fireproof, while the expense of maintenance is less." The Superintendent of Motive Power of the Western Railroads of France says: "I have the honor to inform you that metal frames have been substituted in an almost general manner for wooden ones in cars of recent construction." Perhaps the strongest argument which I can present for metal under frames is a copy of the statement which influenced our opinions and determined our conclusions in favor of metal cars. The statement shows the repairs executed from April, 1890, to April, 1893, on the 50 cars which we had leased from the Iron Car Company, and the cost of these repairs. It will be seen that two cars were wrecked. With that exception you will notice the light character of repairs executed, and the fact that absolutely none were required upon the under frames. This good record was made in face of the fact that the cars have during the whole five years been carrying heavy loads, and always run in trains containing 50 or 60 cars. Nor must it be supposed that the frames required repairs which they did not obtain; on the contrary, the cars have been always in good condition, and the frames for all practical purposes are as good as new. At the end of our lease, in August last, these cars were inspected by Mr. C. W. Walker, Master Mechanic of the Seaboard & Roanoke Railroad, and Mr. W. A. Brown, Master Mechanic of the Atlantic & Danville Railroad. Their report shows that the only defect which existed in the under frames was one damaged tube or sill.

The total cost of repairs to these 50 iron flats for three years, leaving out wrecks, wheels, and brasses, has been $163.32, an average of $1.10 per car per annum. I must say, however, that the timber platforms will soon require thorough repairs, and the iron work needs a coat of paint.

For the purpose of contrasting our experience with metal frames with the experience of other people having timber flat cars, I made numerous inquiries with the hope of obtaining the cost of maintenance of such cars, their average life, and the percentage of repairs and rebuildings due to wrecks, but was unable to procure any information from which general conclusions of value could be drawn. The average life of such cars was given as from seven to 17 years; and in reference to the percentage of repairs and rebuildings due to wrecks, I can only quote what was said by Mr. Barnes at the last Master Car-Builders' Convention, that it amounts to 6 per cent. on large roads. Therefore the only statement which I can submit as to the cost of repairs of wooden cars is one from my own road showing cost of maintenance for 50 wooden cars for the same three years. I must, however, say that these timber cars were three years older than the iron ones, and the peculiarly destructive effect of our climate must not be forgotten. This statement shows the total cost of repairs to 50 wooden flats for three years, leaving out wrecks, wheels, and brasses, has been $2,664.49, an average of $17.76 per car per annum, 17 times as much as the iron cars which, I think, gives a sufficient reason for our preference in favor of these cars, and proves conclusively that metal frames are superior to wooden ones, if only they are built to suit the heavy traffic of to-day, and with strength commensurate to the work and abuse to which they will be subjected. If they are built strong enough it is difficult to predict how far-reaching the results from their use may be. The latent possibilities of the steel car are unlimited, and it is certain to triumph in the end; and if I have induced you to look at this question from my point of view, it only remains for you to consider whether the time has yet arrived for the general introduction of steel cars on the railroads of this continent, or whether the work is to be left for the next generation to accomplish.

MARINE NOTES.

Unsafe Gunboats.—The report of the Naval Stability Board, that was appointed to inquire into the defects on a number of the war ships, has been submitted to the Secretary of the Navy in reference to the *Machias* and *Castine*. The Board said that these gunboats are top-heavy and unstable and recommends that the two vessels shall be lengthened 14 ft. The estimated cost of the alteration is $30,000.

The Proper Color for Torpedo Boats.—Germany's naval experts have decided that the best color to paint their cruisers and torpedo boats, in order to make them as difficult of observation as possible, is a kind of dirty buff. They recommend that the whole of the vessels should be uniformly coated with this color, and that nothing on their decks or upper works should contrast with it.

Wooden Ships in the Navy.—The old wooden ships of the Navy are gradually being retired from active service. The flagship *Lancaster* is now on her last cruise. When relieved by the *Baltimore* she will return to New York and be transformed into a receiving ship, to take the place of either the *Minnesota* or *Vermont*, which are both in a state of decay. Another ship that will soon follow the *Lancaster* to the graveyard of all old naval vessels is the *Alliance*, now at San José. She will leave in the next few weeks for New York, and is also to serve as a receiving ship. The *Marion*, *Mohican*, *Adams*, and *Yantic* are still in service, but their days are numbered. The *Yantic* is in the South Atlantic, and will return home shortly to be placed out of commission. She is now on her last cruise. The *Adams* is not good for many more months, and the *Marion* is little better. There will be two wooden vessels in the Navy for many years, however, as, by special act of Congress, the *Hartford* and the *Kearsarge* are exempted from the repair limit of 10 per cent., and will thus be saved. The *Hartford* is being rebuilt, and will prove a good vessel for many years, and the *Kearsarge* is now in fair condition. But with the exception of these two every wooden ship in the Navy will disappear within the next year or two.—*Washington Star*.

PROCEEDINGS OF SOCIETIES.

Engineers' Club of Philadelphia.—At the meeting of this Club on January 6 Mr. A. Falkenau described some interesting features in the department of mechanical engineering at the World's Fair. He expressed the opinion that the disappointment expressed by many engineers regarding the mechanical exhibits was partly due, not so much on the part of the exhibitors as to the fact that the different fields of the application of power had been so thoroughly exploited that novel forms are few, and advance is confined to minor details. He gave a full description of the Yerkes telescope, some air compressors, and certain riveting machines.

Engineers' Society of Western Pennsylvania.—At a recent meeting Mr. D. Ashworth read a paper entitled "Indifference to Boiler-firing and Management." He stated that in experience extending over a period of a quarter of a century he had found that there had been a continuous decline in the grade of service of those in the positions of firemen and boiler-room managers, that the evil had become so glaring and the results so palpably fraught with disaster, destruction and waste, as to warrant an effort to call the attention of those who desire to progress to the false and inconsistent position which they occupy, by permitting such a narrow policy in management, so widely at variance with true economy, ignoring directly that the better intelligence renders the more valuable and hence more profitable service. He stated that the intelligent engineer keeps a constant oversight over every part of the steam plant, and is familiar with the elements of com-