

the re-action of the steam jacket. Then the investigations of Zeuner, Hirn, and his fellow-workers, and the work of a large number of writers and experimenters who in recent years have directed their attention to the subject, are passed under review. The field of review is, however, so wide, and the opinions expressed so various, that it is impossible to give any statement which might be regarded as the outcome of the whole. Professor Thurston has evidently recognised this fact, for he has not attempted a summary of his investigations, but has contented himself with merely stating opinions and facts on the authority of those whose names he gives. It would have added much to the value of his paper if he had at least stated the thermodynamic principles of efficiency in a more distinct manner. He might then have classified the results of experiments according to conditions, and shown how these agreed with what might have been expected from the teaching of theory. We hope he may still do this in a supplementary paper, which will afford a more definite basis for discussion than the one we are considering. We must confess, however, that we have not very much faith in any of the experiments which have yet been made, for it is utterly absurd to go on discussing the subject so long as we have practically no information regarding the nature or quality of the steam which is used. We have recently drawn attention to this, and we hope that future experimenters will consider it their duty to at least try to ascertain the percentage of water in the steam supplied to the engine under experiment. We are quite aware of the difficulties of the problem, but unless these are faced and overcome all experiments must be very unsatisfactory.

There is at least one point on which all the opinions quoted are unanimous, and that is that it is absolutely necessary that the jacket should be supplied with steam at a higher pressure than that used in the engine. This may seem so self-evident that it is almost unnecessary to state it, but cases are not unknown even yet where engineers are content if they get steam of any kind into the jacket. With regard to marine engine practice, the opinion of Dr. Kirk is, of course, valuable. He says: "No doubt, in the earlier non-compound engines, when the steam was worked through a large range of temperature, jackets were a very valuable addition; but, as far as he had observed, with the ranges of temperature in the best compound, and in the modern triple-expansion engine, he could not trace any advantage. The ideal function of a steam jacket was a neutral one: simply to prevent condensation. Unfortunately it also acted as an evaporator. When so acting it was in fact a boiler, in which a higher pressure steam was employed to generate steam of a lower pressure. Without going into the ultimate value of its action in the single-acting Cornish engine, it was clear that to expend boiler steam to generate lower pressure steam in the low-pressure cylinder, or even in the intermediate, was not an economical way of using it, the more so as the steam generated in the low-pressure cylinder had little opportunity of doing any work, but went immediately into the condenser. Better it should go in as water. Jacketing the high-pressure cylinder seemed to add nothing perceptible to the heat economy, but contributed sensibly to the wear and tear. The very large volume of water that came from a steam jacket,

although the range of temperature in its cylinder was small, led him to think that the steam thus condensed would be better employed if put into the cylinder itself." Mr. Dyer's opinion, quoted by Professor Thurston, seems to give a *résumé* of the position. He said that "the gain by the use of the jacket may be, in actual work, anywhere from 0 to 30 per cent.; that it should be employed when the ratio of expansion in the same cylinder is large: when the variations of pressure, expansion, and range of temperature are great, its value is doubtful; that superheating is a better method of reducing wastes; that the higher the engine speed the less the value of the jacket; from a theoretical point of view the jacket would be considered desirable on the small cylinder, but practically it is found that it is better to omit it from the cylinder, as it observably exaggerates wear; that the use of the steam jacket is contrary to the thermodynamic principles of efficiency." It will be seen that Professor Thurston's paper contains much information and leads to many points of discussion. We shall be glad to have the opinions of some of our engineering readers regarding it, as supplementary to the discussion on "Steam Engine Economy" which has been recently carried on in our columns.—*Industries.*

A PROPOSED SHIP 1,000 FEET LONG AND 300 FEET WIDE.

At the recent convention of the Iron and Steel Institute, at Pittsburg, Sir Nathaniel Barnaby, K. C. B., constructor for the British Navy, read a paper on "The Protection of Iron and Steel Ships against Foundering from Injury to their shells: including the Use of Armor." In this he gave expression to his own theories as to the value of armor. He said that we are greatly worse off in these days of steel and iron than when ships were built of oak, teak and pine, as to the perils arising from perforation of the shells or hulls of ships. Increased speed and increased momenta in collisions had increased the risks, and at the same time the material of which the hull is composed submits so easily to perforation that he was inclined to value the opinion of many eminent men who are strongly opposed to the abandonment of wooden bottoms, both in commerce and war. One-fiftieth of the value of the vessels in the mercantile marine, he said, was required annually to make good losses and repairs entailed by collisions alone. He prophesied that America, possessing nearly one-sixth of all the wooden sailing ships of 100 tons net and upward in the world, would probably find it to her advantage for many years to come to continue the use of wooden ships.

In the course of his paper the essayist suggested a most interesting possibility in the development of passenger steamships. He said:

"I have never thought that size is a disadvantage in merchant ships, supposing they can be worked financially. On the contrary, the advantages arising from size in passenger ships seem to me to be so great that I do not see where we shall stop.

"I was consulted some years ago by a business man, well known on both sides the Atlantic, as to