A REVIEW OF MARINE ENGINEERING DURING THE PAST DECADE.*

Reply to the Discussion of the Engineering Association of N.S.W. on the above paper, by Mr. A. Blechynden.

It is customary when a paper is read and discussed that the writer should have the courtesy to reply, and be awarded the privilege of replying to those who have done him the honor of esteeming his views worth criticism.

Now, on account of the unfortunate way in which matter has limited the freedom and rapidity of interchange of ideas, it so happens that now, in October, 1893, I have just been reading your Association's Discussion of my paper, "A Review of Marine Engineering during the past decade," on March 24th, 1892.

But in spite of the affair being somewhat *passe*, and of the delay which has occurred since I received the report of that discussion, it may not yet be quite out of place on my part to reply to some views expressed at that time.

But the main part of the discussion seems to have turned to the question of feed heating, in regard to which, although more than two years have passed since I wrote the paper, I have seen no sufficient reason to change my view.

I am fully acquainted with the public experiments of Messrs. Anderson, Bramwell and others, but do not think that

* This paper was published in Volume VII. The Editor regrets that it was not possible for this reply to appear in the last volume on account of the delay in issue it would have caused,

they bear sufficiently on the point, as they relate to the transfer of heat from steam—and I suspect fairly wet steam—at one side of a plate or tube to water at the other, and not as in an ordinary steam boiler, from dry heated gas to water, and it does not necessarily follow that the same law holds in both cases. The experiments quoted by Mr. Fitzmaurice, which show a gain of 18 per cent. in economy by feed heating, in the working of the particular engine to which he refers, are much more to the point, but I submit that they do not prove the case, *i.e.*, the *general* advantage from an *economic* point of view of feed heating by live steam.

I am fully justified in referring you to the results published in the paper in table 5.

It will be observed that in the last column of that table, under the head of remarks, that letter "H" appears frequently, indicating that in those cases a feed heater was fitted and working. At the bottom of the last page of that table the averages of the vessels are summed up, and are again subdivided into forced and natural draught. I shall now still further sub-divide those under natural draught into those without feed heater or pass-over valve, with feed heater and no pass-over valve, and without feed heater but with pass-over valve. They are as follows:—

	Hs. per I.H.P.	Coal per I.H.P	No Cases.
	Sq. ft.	lbs.	
Without feed heater or pass-over valve ...	3·4615	1·5665	10
With feed heater, no pass-over valve ...	3·930	1·648	9
Without feed heater, with pass-over valve ...	2·85	1·400	3

Now here we have an almost equal number of cases under otherwise practically similar conditions, with and without feed heaters, yet such difference as there exists is against rather than for the heater, and I submit that were such an improvement in economy (as Mr. Fitzmaurice has shown) a necessary accom-

paniment of feed heating, some of it ought to have been evident. I might now rest here, but it may be interesting to observe what experiment has to say respecting the matter, for most carefully conducted experiments have been carried out on the rate at which heat is transmitted through boiler plates from heated gas, as in an ordinary boiler furnace, to water being evaporated with cold feed—as well as with the feed water heated nearly to boiling point; also to water being heated from one temperature to another under the boiling point.

I shall not describe the apparatus, as I have already done so in a paper read before the Institution of Naval Architects, and published since in the ENGINEER.

It was evident from those experiments, that the rate at which heat was transferred was proportionate to the square of the difference of the temperatures on the two sides of the plate when water was being evaporated. No results for heating were given in that paper.

For a steel plate $\frac{3}{8}$in. thick, water evaporating at atmospheric pressure, and for furnace temperatures, varying from about 700 to 1,400° F. and feeds from 62° F. to 210° F. the value of—

$$\frac{\text{Heat transmitted per square foot per hour.}}{(\text{Furnace temperature} - 212)}$$

—varied only over a range of four per cent, due evidently to the ordinary errors of observation, its mean value being ·02404.

For the same plate transmitting heat to raise the same temperature of water only, the water flowing continually through the boiler, the value of—

$$\frac{\text{Heat transmitted per square foot per hour.}}{\text{Initial difference of temperature} \times \text{final difference}}$$

of temperature varied in value somewhat with the furnace temperature, so as within the limits of the experiments to make the value of—

$$\frac{\text{Heat transmitted per square foot per hour.}}{(\text{Furnace temperature} - 212°)^2}.$$

practically constant, having a mean value of ·024006, or identical with the modulus for evaporation.

This same fact was observed in the case of a plate ·8125 thick, its moduli being for—

Evaporation	...	...	...	...	·01819, and for
Heating ...	...	...	...	...	·01805.

It is evident that there must be some limit to such a law for the transfer of heat while heating, otherwise heat would not pass through a plate from gas at 212° F. to water at a lower temperature, but over the range of the temperatures which varied from about 600° F. to 1800° F. it held—the plain English of it being, that whether heating or evaporating at atmosphere pressure (and very probably at any other pressure) the rate of transfer of heat is the same for that pressure and for the same furnace temperature.

If, therefore, cases are found where feed heating by live steam results in superior economy, and it appears evident that such cases are on record, I think it is quite clear that an explanation of the phenomenon must be sought for in some other direction than in the efficiency of the heating surface, or the greater rate at which heat is transferred.