XXVIII. *Supplement to Mr.* Macquorn Rankine's *Paper "On the Thermodynamic Theory of Steam-engines with dry saturated Steam, and its application to practice*."*

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The following additional information respecting the steam-ships referred to in the examples may be interesting, although it does not strictly belong to the special subject of the paper.

Example I.—Paddle-steamer 'Admiral,' built by Mr. James R. Napier; engines made by Messrs. Randolph, Elder and Co.; draught 7 feet 6 inches; length 210 feet; breadth 32 feet; displacement 820 tons; speed with 774 indicated horse-power 11·9 nautical miles an hour. Effective work in driving the ship, about 604 horse-power.

Available heat expended per hour in foot-pounds per indicated horse-power,

$$\frac{1{,}980{,}000}{\text{efficiency of steam}}=\frac{1{,}980{,}000}{0{\cdot}123}=16{,}100{,}000.$$

Coal burned per indicated horse-power per hour, 2·97 lbs.

Available heat of combustion of one pound of coal,

$$\frac{16{,}100{,}000}{2{\cdot}97}=5{,}420{,}000 \text{ foot-lbs.}$$

The total heat of combustion of one pound of the coal employed being roughly estimated at 10,000,000 foot-pounds, it appears that the efficiency of the furnace and boiler was about 0·542.

The boilers were improved marine boilers of ordinary proportions.

Example II.—Screw-steamer 'Thetis,' built by Messrs. C. Scott and Co.; the engine made by Messrs. Rowan and Co.

Available heat expended per hour in foot-lbs. per indicated horse-power,

$$\frac{1{,}980{,}000}{\text{efficiency of steam}}=\frac{1{,}980{,}000}{0{\cdot}192}=10{,}312{,}500.$$

Coal burned per indicated horse-power per hour, during an experiment of one hour's duration, 1·02 lb.

Available heat of combustion of one pound of the coal employed,

$$\frac{10{,}312{,}500}{1{\cdot}02}=10{,}110{,}000 \text{ foot-pounds.}$$

The coal used was of very good quality; and its total heat of combustion per pound is

* Philosophical Transactions, Part I. 1859, p. 177; Proceedings of the Royal Society, January 1859.

estimated at 11,560,000 foot-pounds. Hence the *efficiency of the furnace and boiler was*

$$\frac{10{,}110{,}000}{11{,}560{,}000}=0{\cdot}88.$$

In this case the short duration of the experiment on the consumption of coal, which was interrupted by a fog, makes the result less satisfactory than it would have been if the experiment had been continued, as intended, for several hours. The engine and boiler were of a kind invented some years ago by Mr. CRADDOCK; the boiler consisting chiefly of a sort of cage of vertical water-tubes enclosing each fire-grate. The heating surface was about nine times as great, relatively to the fuel burned, as it is in ordinary marine boilers.

EXAMPLE III.—Paddle-steamer 'Callao,' built by Messrs. JOHN REID and Co.; the engines by Messrs. RANDOLPH, ELDER and Co.; displacement 1100 tons; speed with 1176 indicated horse-power 12·05 nautical miles per hour.

Available heat expended per hour in foot-pounds per indicated horse-power,

$$\frac{1{,}980{,}000}{\text{efficiency of steam}}=\frac{1{,}980{,}000}{0{\cdot}14}=14{,}143{,}000 \text{ foot-lbs.}$$

Coal burned per indicated horse-power per hour, 2·67 lbs.

Available heat of combustion of 1 lb. of coal,

$$\frac{14{,}143{,}000}{2{\cdot}67}=5{,}300{,}000;$$

being nearly the same as in Example I.

The boilers in this case were, like those in Case I., improved marine boilers of ordinary proportions. In such boilers, 5,400,000 foot-lbs. may be considered a fair estimate of the available heat of combustion of good ordinary steam-coal.