transmission of power, ventilating and cooling. Electricity had taken the field for tramways, except where gradients were too severe for ordinary adhesion working. It was doubtless destined to largely supplant other means of transmission, though each possesses its proper field.

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“Important Questions in the Economic Working of Steam-Engines and Boilers.”¹

By BRYAN DONKIN, M. Inst. C.E.

Steam pressures between 150 lbs. and 250 lbs. per square inch were now used. Cylinders should be efficiently jacketed to obtain the best results, both on the barrels and covers. Clearance volumes should be as small as possible, and the surfaces flat and smooth. High revolutions and piston-speeds were now much in vogue, especially with single-acting engines. The superheating of steam, and the balancing and lubrication of moving parts, received more attention now than formerly. Steam-pipes and flanges should be well drained and clothed.

The efficiency of steam-engines was best expressed as thermal units per I.H.P. per hour. Boiler efficiency was now more studied than formerly. Analysis of the chimney-gases was most important in boiler trials. Automatic stoking led to economy, but was less used in marine-work than might be expected. Water-tube boilers had largely come into favour during the last ten years, as had also feed-water heaters. The highest boiler efficiency was obtained with an evaporation of between 4 lbs. and 5 lbs. of water per square foot of heating-surface per hour. Generally speaking, internally-fired boilers were more efficient than those fired externally.

It was very desirable that all steam-engine and boiler results should be tabulated in a uniform manner. There was now much confusion, as experiments were published in various ways and under different headings by different authorities. The Author suggested that a small committee be appointed by the Council of the Institution of Civil Engineers with a view of determining the

¹ *The Engineer*, vol. lxxxiii. p. 537; *Engineering*, vol. lxiii. pp. 735 and 758; *The Electrician*, vol. xxxix. p. 151.

best set of headings for the detailed statements of results. Such a standard method would be found very useful for a more rapid and accurate comparison of experiments. The proposed form should be as practical and simple as possible.

In the United States boiler experiments were now nearly always published in accordance with the uniform system of headings recommended and adopted by the American Institution of Mechanical Engineers. Any additions could be made by any experimenter at the end of the standard form to suit special requirements.

No. 2.

“Separate Condensing Plants.”¹

By HENRY DAVEY, M. Inst. C.E.

Appliances for economising condensing water were divided into (1) cooling ponds; (2) evaporative condensers; (3) atmospheric condensers; and (4) methods of cooling water to be used over and over again. (1) Cooling ponds required too much space for general adoption in towns. The Author provided 2·5 square feet of water surface, and 12·5 cubic feet of water per lb. of steam condensed per hour. (2) Evaporative condensers were now being rapidly developed. In general principle the steam was exhausted into a nest of tubes, down the outside of which condensing water trickled. The condensing effect was much augmented by an artificial current of air. After leaving the evaporative condenser, the steam might pass through a supplementary surface condenser. Power was required for circulating the water through the evaporative and supplementary condensers, and for working the air-pump and fan. From 1 lb. to 1½ lb. of condensing water was required per lb. of steam. The cooling surfaces should be not less than 1 square foot per 10 lbs. of steam per hour, and that of the auxiliary condenser 1 square foot per 55 lbs. of steam per hour. The weight of water circulated should be twenty times that of the steam. (3) The principle of atmospheric condensers was the same as that of evaporative condensers, except that the heat was abstracted by a current of air instead of by water. A large

¹ *The Engineer*, vol. lxxxiii. p. 538; *Engineering*, vol. lxiii. pp. 738 and 759; *The Electrician*, vol. xxxix. p. 152.