foot of fire grate surface per hour. The greater rapidity of combustion with forced draught enables a smaller fire grate to be used for the development of equal power than is necessary for natural draught. More complete combustion giving a higher temperature may be obtained in a furnace with forced than with natural draught. The heating surfaces of the boiler are also more efficient, because there is a greater difference in the temperature of the water surface and fire surface of the metal forming the heating surfaces. As the rate of transfer of heat varies as the difference in the temperature of the water on one side of the plate and that of the fuel gases on the other side, the greater this difference the greater the amount of heat which will pass through a unit of heating surface in a given time.

The higher rate of evaporation obtained with forced draught permits the use of smaller boilers for engines of a given indicated horse power than are necessary with natural draught. The economy that may be obtained with combustion with forced draught in a steam boiler is due to the increased rate of combustion and the increased efficiency of the heating surfaces produced by it, resulting in increased boiler power. The increase of power obtained depends principally upon the quantity of air brought in intimate contact with the fuel in a given time, but the power of a boiler may be generally increased from 40 to 100 per cent. by the application of well-arranged forced draught. It is difficult to increase the power of a boiler by forcing the draught without increasing the ratio of consumption of fuel per unit of evaporation.

Economy can only be effected when the quantity of air brought o intimate contact with the fuel is less in weight per pound of fuel consumed than is obtained in combustion in natural draught. To prevent waste of heat, it is necessary that the heating surfaces of the boiler be so arranged as to absorb the greater amount of heat generated in a given time by the increased weight of combustion. If these conditions do not exist, the rates of consumption of fuel to water evaporated invariably increase with the use of forced draught. It should not in a general way be less than 10 inches thick, and it should not be allowed to burn less than seven inches before more coal is put on. A thin fire causes loss from the entrance through the fuel of an excessive supply of air. The stronger the draught, the thicker must the fire be. The height between the top of the fire and the crown sheet of the furnace should not be less than 10 inches, and preferably more.—[Manufacturers' Gazette.

Water Power and Electricity.

At a recent meeting of the British Association for the Advancement of Science a paper was read by A. B. Snell, entitled "Utilization of Water Power by Electricity." In substance he said that with coal at the average price of the last ten years it was not probable that water power would prove much cheaper when the capital invested, cost of maintenance of the electric plant, and interest were taken into account. There were, however, special cases, such as the Manchester Water-works, which form a magnificent series of artificial lakes and could be used to drive turbines and give electric energy for lighting the various towns in their vicinity. Another example suggested was the case of Greenock, where there was a fall of many hundred feet, and the water was only partly utilized to drive the mills. The most important instance of the application of water power for the electrical transmission of power in Great Britain is, the paper said, that at the Greenside silver lead mines in Cumberland. These mines are among the few that find it possible to compete with foreign mines, and this is chiefly because the use of electricity for winding, hauling and pumping has decreased the cost of working. The fall at the station is equivalent to a vertical head of 400 feet, and the effective horse power is about 200. The generating station contains one of Gilkes & Co.'s vortex turbines of 100 horse power, driving a compound dynamo. The current is conveyed by bare copper conductors on poles, the distance being 6 furlongs, to which it enters the mine at an elevation of 1,850 feet above the sea-level. The conductors from this point are insulated and covered with lead. About ¼ mile in the mine, or 1½ miles from the dynamo, a o horse-power series motor is employed to wind ore from the set of sinkers. Further into the mine is fixed another 9-horse power motor, working a three-throw pump, forcing the water 460 feet in height. Half way between these motors the pressure is reduced from 600 to 250 volts for working an electro-locomotive in the lowest level of the mines, through which the water pumped from the 120 yards level, and the whole of the water used by two hydraulic winding engines, is pumped. The total weight of the locomotive when loaded is 18 tons. The conductors in the level are phosphor-bronze wires. Great difficulty was experienced in fixing this plant. All main stations in the mine are lighted by incandescent lamps in series of six. The author was of opinion that where possible water power should be wholly used; or, if there be not sufficient water for the purpose, hydraulic power such as there was should be used, and steam engines installed as auxiliaries. In this way the cost of working could be considerably decreased.

Professor Unwin, commenting upon the paper, regretted that the author did not give estimates of the cost of installing water power or the cost of working. In America, said he, there are many schemes being worked but too often at a loss, or, at any rate, no profit. In favorable cases water was undoubtedly cheaper than coal when at