

this saving must be very definite to be commercial, as the upkeep of the stoker has to be provided out of it.

Steam superheating, although increasing rapidly in favor, is still conspicuous by its absence in many plants where it could very readily be adopted with a distinct gain in economy. No matter whether the steam is to be used in an engine or for heating purposes, the gain due to superheating is very marked. The ill-effect of condensation in steam-pipes is cumulative, and the application of steam-traps to remove the water offers a fine field for further waste. Pipe covering is frequently only literally applied, all the flanges being left bare. Although gills and flanges are recognized as necessary adjuncts on radiator pipes, it is strange that when an attempt is made to prevent radiation from steam pipes these are the very parts which are usually left bare. The excuse is sometimes offered that leakage and the necessity for attention to joints prevents the adoption of cover to flanges. If the joints are properly made and the flanges stiff, they may be safely covered up and their existence almost forgotten. The water formed by condensation at a flange will often cause a leakage that would never have occurred if steam only had been present.

Water heating by economisers may be adopted where the draught is good, and the heat in the gases can be spared as in mechanical draught installations. An economiser, as was shown by Mr. Melville last session, is not only a direct source of economy in itself, but the hot feed water increases the evaporative capacity of the boiler, and, what is more important still, it prevents local cooling and so saves straining the boiler. Internal heating apparatus is again coming to the fore. Several types are now on the market which are, perhaps, more useful than novel. The older types of this apparatus gave trouble from water hammer when the pump was stopped. This fault must be carefully guarded against. The makers of later models deny any trouble of the kind. When economisers are used, care should be taken to prevent cold water being pumped into them, as it causes sweating and rapid deterioration.

Water heaters, both of the open and closed type, are most valuable in the case of non-condensing plants. An open heater will raise the temperature of the water to the temperature of the exhaust steam, as there is no loss due to the heat necessary to drive the heat through the plates or tubes as occurs in a closed heater. The scale and deposit formed may be quickly removed from the trays upon which it settles, access being obtained by doors which only need to be exhaust-steam tight, so pipe joints or pressure joints have to be disturbed. The facility with which the water can give up the air absorbed in it is another point in favor of the open heater, as such air is apt to cause pitting in the boiler. An objection to open heaters is that they must be put in the suction side of the pumps and at some elevation above them, otherwise the hot water vapors under the pump bucket and the pump loses its water. Where the water is hard, special care should be taken to catch in a settling tank or filter any small crystals of lime which do not stick on the trays, otherwise the pumps may get badly cut. Closed heaters, whether of the plate or tubular type, very quickly

drop in efficiency, due to the deposit of scale on the water side and oil on the steam side of the heating surfaces, and so increase the normal difference in temperature between the steam and water. They are much more difficult and costly to clean than open heaters, and so the evil cleaning day is kept off as long as possible.

Air heating has been tried again and again, but it is very doubtful if it pays. Perhaps the greatest advantage it possesses is in the suppression of smoke, and in that field it certainly has an important place. Smoke prevention has been run hard both by fanatics and by those who are really anxious to see trade carried on upon a commercial basis with the least possible inconvenience either to the traders or their neighbors. All who have considered the matter will admit that, although black smoke means waste, it is not equally true that a smokeless chimney means economy. On a series of tests the lowest efficiency was recorded with a minimum amount of air, and the highest with a moderate amount of air, when some smoke was made. Every effort should be made to prevent the emission of smoke, the underlying principle of which is the admission of the proper quantity of air at the proper time, and the removal of cooling surfaces so far as is possible from the gases until combustion is complete, as if the temperature is lowered below the critical temperature, before combustion is effected, no amount of care in air regulation will prevent smoke. The Smoke Abatement Society made a step in the right direction when they last year started lectures for firemen, and the question has been handled in a very practical way by the Smoke Prevention Society in Hamburg, where carefully watched tests have educated the firemen and led to increases in efficiency up to 14 per cent., on hand-fired boilers.

The main causes of waste in the engine-room are steam-pipe condensation and leaky engine valves. The steam-pipes in a plant are very often out of all proportion to the actual requirements of the engines, not only in length but in diameter. Duplicate ring mains in the boiler-room and engine-room are common, but a proper arrangement of pipes and well-made joints does not call for such an expensive insurance against a shutdown. The benefit of shortening the path of the steam between the boiler and engine cannot be overestimated. Good lighting is conducive to economy in both engine and boiler rooms, as plant in a badly-lit room never gets properly looked after or cleaned. Why should it? It is no credit to the cleaner if it cannot be seen! Dirt is about the worst disease a plant can suffer from, as it invariably means neglect of small indications and warnings, timely attention to which would prevent the otherwise inevitable breakdown. Not only is the plant better cared for, but men all work better in cheerful surroundings and lose less time through sickness.

TESTS.

It is an unfortunate fact that in many cases an engineer-in-charge does not really know what his plant is doing, and all for the want of tests, which he could carry out himself with very slight expense or inconvenience. Coal may be weighed without appreciably increasing the cost of handling it. Water may be measured by positive meters, which do

not need much attention so long as they are not run at a high speed or cut by grit. An interesting and novel type of water-meter is Lea's notched weir, which is very simple and not likely to be put out of action by the causes that affect other water-meters. It is a very ingenious application of an indicating and recording attachment to measure the flow over a V notch, the value of which was first investigated by Prof. Jas. Thompson about 50 years ago. These two measurements, coal and water, give sufficient data for checking the cost of evaporation, which is the most important factor in the works cost of private plants. I believe that no single factor has contributed more to the economical running of electricity supply plants than the analysis and publication of their figures by the press, and I am sanguine enough to believe that if one of the members would collect data as to cost of evaporation in the plants under the charge of members of this association, and present them in the form of a paper, the result would be a healthy competitive stimulant to all concerned.

Engine tests appear to have had more fascination for experimenters than boiler tests, but comparison of records goes to show that there is not much difference in the efficiency of different types of boilers which vary largely in design; certainly the figures are not so far apart as are the results of tests of similar boilers worked under different conditions. This puts all the stronger emphasis on the necessity of an engineer-in-charge knowing what his boilers are doing. The more a man knows of his plant the keener will he be to keep its performance up to the highest level obtainable, and nothing shows a staff the capabilities of a plant and secures confidence in it better than a few tests, the educational value of which on all concerned cannot be overestimated. So far as I have been able to find out, there does not appear to be much published on the cost of steam generation over long periods. In an appendix to the late Mr. Bryan Donkin's "Heat Efficiency of Steam Boilers," some useful figures are given. I would like here to remark how much those of us who are interested in boiler problems miss our late friend, to whom we were repeatedly indebted for useful hints and data. Two factories, Rothwell and Duneberg, were under the same management, and experiments seem to have been prompted by the high cost of evaporation at Rothwell in the previous year, which amounted to 19.4s. per 1,000 gallons. In the following year the cost was reduced to 13.63s. per 1,000 gallons at Rothwell and 10.81s. at Duneberg. Further experiments were made, and it is stated that the cost of evaporation fell 39 per cent. at Rothwell and 28 per cent. at Duneberg, representing for one year alone a gain of £6,000. In 1905 results of a ten weeks' test at Sheffield were reported by Mr. Fedden, which, with coal at 5s. 8d. per ton, worked out to 3.57s. per 1,000 gallons for coal only, and for coal, labor, etc., to 9.32s. These results both look excellent, but if they are translated into London figures with the same coal, they would be of the order of 7s. and 13s. 6d. respectively. In one of the works with which I was connected