23rd April, 1903.

ABSENCE OF ECONOMY IN THE MANUFACTURES IN AUSTRALASIA, SPECIALLY DEALING WITH THE MOTIVE POWER END.

By R. S. Vincent.

The author desires to draw attention to the very evident apathy existing in manufacturing circles as to economy in motive power appliances, and considers that our existence as a people depends upon our commercial success as compared with the success of other nations. To bring this successful issue about, it is necessary to produce at least as cheaply as others with whom we enter into competition. It is only too evident that in the majority of cases in Australia the economic cost of production is very often a point that is lost sight of. The attention of members is drawn to the motive power end more particularly than to the internal economies in the various manufactures, the author being of opinion that in many cases the motive power is old in design, absolutely wasteful, and, through neglect, is in such a condition that breakdowns are frequent, and the consequent loss greater. In this connection, he had heard many American gentlemen say that the Australian people were "too slow to catch cold."

Years ago a very serious complaint was made by British and Continental wool-buyers, that a great proportion of the best parts of the fleece was spoilt by the branding; yet years elapsed before any serious notice was taken by the producers. A similar complaint, attached to hides being branded in the best cuts, received the same tardy recognition.

In many parts of Australia, agriculturists had been content to trust to a very unreliable rainfall, taking a good season, when it came, as only their due, and growling at a bad one as a curse; and a curse it surely was to some extent, but brought on the sufferers by their own wastefulness and want of forethought, especially the neglect of systematic irrigation. Considering the importance of irrigation, it would be generally admitted that the Water Conservation Committee had not been appointed a moment too early.

The proper combustion of fuels also takes a place in the matter of economies, and when the great difference in the colour and volume of the smoke from the power-house at Ultimo is seen, as compared with ordinary plants, one could only confess that they were adopting a system there that must prove economical. Such change was being brought about by that best of smoke-consumers, and therefore the most economical coal-burner—the mechanical stoker. The author thinks he will have the majority of members with him when he asserts that the more complete the combustion of fuel is in the heating-surface spaces, especially those portions of the heating-surface spaces in which the gases are liberated, the greater is the economy of the apparatus. The Stirling, Hornsby, Babcock and Wilcox, the Belleville and their class, have shown what can be done in respect to rapid circulation of water and the liberation of steam particles in the best manner. At this point one naturally thinks of the benefit of feed-water heating and super-heating steam; yet what a lamentable absence is there in many of our factories of these most essential aids to economy. In most cases where feed-water heating obtains, the methods adopted are behind the age, and the efforts to use super-heated steam are few and far between; yet the benefits of super-heating are enormous. With reference to condensation, the author considers there is a most conspicuous absence thereof, except perhaps in steam pipes and cylinders.

Again, and perhaps not the least important point, is the use of the simple engine and comparatively low steam pressures, as against the economy attaching to the compound and triple expansion engines with high steam pressures; and, although these economies can be obtained, how few there are that are using multiple expansion engines with high steam pressures. The majority are content with boilers working at 60 to 70 lbs. to the square inch, and, with simple engines non-condensing, cold feed-water boilers that are sending at least 8 to 10 per cent. of those heat units, which could be turned into work, into the atmosphere.

As a member of the Association, the author asks whether the advisory engineers are not in some sense responsible for this want of economy—this too evident waste of valuable power. Are they pointing to the economies of the producers in other countries, when advising those who consult them, and stating what should be done; or are they, for the sake of some saving in initial expenditure, allowing the producers in this country to try and produce with systems which should be considered obsolete? Is it that the Americans are right? Are we not sufficiently energetic to endeavour to beat the foreign producer at his own game, or, at the very least, adopt his systems where they are valuable?

The author does not intend to make any mention of pneumatic tools and their advantages. Many of the best types are coming into the country, and in this respect the people are beginning, though slowly, to appreciate their benefits.

Finally, the author thinks that, as an Association, we should not only lend ourselves to the pursuit of all information on economic principles, and the distribution of that knowledge to whom it is of use, but advise and insist on the adoption of better methods; and then they may hope to compete successfully with the manufacturers of the world, and guard against the distress brought about by want of foresight, and by not applying to their use the benefits of scientific research and engineering skill, such as makes the individual famous and the nation truly great.

Taking the municipal area of Sydney alone, there are 186 steam users, and it cannot be denied that most of these steam users are running their steam ends most uneconomically. These 186 steam users possess amongst them 304 boilers of various sizes, the total nominal horse-power of these boilers aggregating 8,850, or, taking the effective horse-power as averaging two to one of the nominal, an effective horse-power of nearly 18,000. These figures do not include the power used in any of the Government works, nor do they include the power used by contractors on large buildings, most of whom nowadays use steam machinery for hoisting. Of these steam users probably not more than twenty are using condensing plants. Taking the total horse-power in the municipal area alone as at 18,000 effective, and rounding up all along the line, the coal bill for the aggregate would be about £108,500 per annum; that is, taking an average of twenty hours work a day for six days a week, and fifty weeks in the year to allow for holidays, the value of coal at 12/- per ton, and a not inflated consumption of coal per effective H.P. of 3·75 lbs. With the price of coal at 15/-, which is more like its cost per ton at the boilers, the expenditure for coal for manufactures in the municipal area of Sydney alone would be about £135,000 annually. If we allow that the introduction of condensation in these cases would mean a saving of 25 per cent. in coal consumption, then, at the 15/- per ton rate, the total saving to Sydney manufacturers would be £33,750, or at a 20 per cent. saving, a total benefit of £27,000 annually, and this is only for the municipal area of Sydney. There is one excuse generally met with from those people before whom this method of economy is brought—that they cannot get condensing water, and that to use the Sydney supply would be impracticable. This is not an excuse that should be made in these modern days, for, with cooling towers and systems of this nature, the condensation could be carried out easily, and the cost of water would be no greater than under their existing methods—as a matter of fact, considerably less. The author has wondered often that no enterprising syndicate has been formed for the supply of condensiug water in the city.

DISCUSSION.

MR. R. SINCLAIR said that Mr. Vincent had overlooked the most important point in engineering economy—that was, the commercial side. There were many existing conditions which prevented us, as engineers, from securing the highest class of machinery, the most important of all being the want of capital. Mr. Vincent's assertion was rather sweeping when he said that we, as Australians, were too slow and behind the age. In Sydney, the Gas Company and the Colonial Sugar Company were very well up-to-date, and had adapted themselves to almost absolutely the same conditions, economically, to those obtaining in other places, their engines and machinery being pretty much the same.

As a matter of fact, the manufactures, and all individual enterprises, started in New South Wales were more or less by way of experiment, and it would not be wise to invest a large sum in installing new plant until the success of a manufactory was assured.

He had carried out many experiments with pumps and condensing engines, and thought that the author of the paper must have found in his own experience, that, while he was very keen to put in new machinery able to give satisfaction and efficiency, beyond a certain point it could not be done. Of course, economies could be effected on many lines, and the members of the Association were with Mr. Vincent in his desire to get the most up-to-date appliances. When these were secured, Australians would be able to effect as many economies as in other countries.

MR. E. J. ERSKINE considered that the paper opened up a very wide range for discussion. Although he must admit having been rather disappointed that the author dealt almost entirely with the steam-raising portion of the question, he thought there were many other equally, if not more important, matters to be considered by the manufacturers in Australia.

It would seem by the remarks made by the author, that he would lay down a law that every steam-user was foolish not to use water-tube boilers, condensers, feed-water heaters, and super-heated steam. Now, this was a large order, and he (the speaker) did not think that Mr. Vincent would be able to prove that it was always advisable to use these adjuncts.

There were many cases in which cost of steam generation was not absolutely essential, and where it would be wrong economy to spend the money necessary to instal these condensers, etc. Further, in Australia, where the factories were comparatively small, and where the capital to instal such factories was limited, it was very often advisable for that capital to be spent in putting in good tools, and putting up with what might seem bad economy in steam generation.

The figures given by the author—that there were 186 steam-users in the municipal area of Sydney, with 304 boilers, aggregating 8,850 nominal horse-power—were interesting; but the figures in connection with the saving to be made by the introduction of condensers did not appear to allow anything for those boilers that were already fitted with coal-saving appliances, and out of the 18,000 effective horse-power to which he referred a large portion were so fitted.

It was very easy to say that the Australian people in the engineering line were "too slow to catch cold," and he did not doubt that many Americans had made the remark. We should all like to see factories in Australia fitted with all the latest labour and coal-saving appliances, if it could be shown that there was a chance of such factories being a financial success. In his opinion, more harm would be done to this country by enterprises being started at the present juncture, unless they could be carried to financial success, and it probably was better to go slow until the population, which in other words meant demand, warranted the erection of such factories.

Most labour-saving appliances were only such where work could be standardised—that was to say, where a large demand

for a certain article warranted that article being made by the thousand—not, as was the case in Australia, where they were wanted by the dozen; and it did appear to him that, when it was said that our manufacturers and steam-users were too slow, these remarks very often came from people who had not the experience of the peculiarities met with in the Australian factories, and were only talking with a knowledge of what was required in largely-populated countries.

In England at the present time a great change was coming over the methods of manufacturing; all the large factories were throwing out their counter-shafting, and were going in for individual machine driving, and, in the case of small machines' grouping them on to a short shaft. In most cases the method of driving was electrical; in one case, however, of which he had just heard, small gas-engines throughout the factory had proved a great success.

Extracts from Paper by MR. LOWTHER, at Washington :—

The labour cost in most machine shops and other works is so much greater than the cost of power that any expedient by which the labour cost may be appreciably reduced is justified, even though the efficiency of the agent itself be low. Whenever new methods or agencies cause an increased production with the given outlay for labour, we shall find these methods superseding the old, even though the cost of the power required be greater than before. The saving of power is a consideration secondary to the advantages and economical output obtained by its use.

While economy in the use of power should, therefore, be secondary to increased output, yet careful attention to details will often greatly reduce the useless waste of power.

Engineers have recognised for some time past that there is a very great percentage of loss due to shaft friction, which, in railroad and other shops where the buildings are more or less scattered, may be as great as 75 per cent. of the total power used. In two cases known to the speaker these losses are 80 and 93 per cent. respectively. In the ordinary machine shop this loss will probably average from 40 to 50 per cent. No matter how well a long line of shafting may have been erected, it soon loses its alignment, and the power necessary to rotate it is increased.

In machine shops with a line of main shafting running down the centre of a room, connected by short belts with innumerable countershafts on either side, often by more than one belt, and, as frequently happens, also connected to one or more auxiliary shafts, which drive their countershafts, we can see why the power required to drive this shafting should be so large. There is no doubt, however, that a large percentage of the power now spent in overcoming the friction of shafting in ordinary practice could be made available for useful work if many of the present cumbrous lines of shafting were removed.

Manufacturers are realising the loss of power which ensues from the present system of transmission, and we find a general tendency to introduce different methods by which a part of this loss will be obviated. Among these are the introduction of hollow and lighter shafting, higher speeds and lighter pulleys, roller-bearings in shaft hangers, and the total or partial elimination of the shafting.

The following notes from a paper by Mr. Frank Broadbent, which may not have been seen by some members of the Association, would give some idea of the tremendous saving which was being made under such new arrangements :—

1. National Arms Factory, Liege.—Short, straight lines of shafting driven by independent motors. No main lines of shafting used.

Result: Power required per rifle per day is less than half that in any similar factory using mechanical transmission, viz, 1½ h.p. per rifle, as against 3½ h.p.

2. Royal Arms Factory, Liege. — Electric generating plant put down and independent engines replaced by electric motors.

Result: Coal bill reduced to one-third.

3. Compagnie Vielle Montagne, Belgium. — Mechanical transmission replaced by electrical.

Result: 20 stokers and engineers dispensed with.

5. Forest & Co., St. Etienne.—A factory containing 100 looms for weaving quadruple and sextuple plushes, ribbons, &c. Each loom driven by a separate motor varying from ⅓ to 1 h.p. The warping, cutting, glossing and printing machinery all electrically driven. Some dynamos supply both lighting and power circuits.

Remarks: The initial cost was no more than would have been necessary for complete outfit of shafting, &c., for mechanical driving. The lightness of the shops, absence of overhead belting, economy of transmission, more uniform and gentle moving, and better control of machinery are points which all tell in favour of electrical driving.

8. Baldwin's Locomotive Works, Philadelphia. — On electric travelling cranes being erected which formerly necessitated a dozen men were manipulated by two men.

12. Siemens Bros., Woolwich.—Electrical driving throughout the works. About 1200 h.p. used.

Result: A saving of 3000 tons of coal a year, and the wages of six stokers and engineers.

14. Dorman, Long & Co — Portion of works changed over to electrical driving.

Result: Two boilers and six engines dispensed with, and all labour connected therewith, and a saving of 1500 tons of coal a year. System being extended.

17. Cambois Colliery, Northumberland.—Seven motors of 8 h.p., each driving underground pumps, replacing endless wire transmission.

Result: Annual coal consumption reduced from 1500 tons to 450 tons. The labour of two men and two boys dispensed with. Total saving about £1,000.

When going about among the steam-users in Australia, what always struck him as extraordinary was the want of thought in connection with the steam pipes, and he ventured to think that in many cases a great saving could be made if more consideration were given to this waste. The very long lengths of steam pipe, in many cases without any lagging, must mean very great losses due to condensation, and the cost of reducing these losses would be comparatively small.

Mr. J. Scoular said that, in discussing the points raised by the author, one would almost require to possess a general knowledge of what is actually being done in this direction throughout the whole of the colonies, to enable him to speak with confidence upon the question.

He had pointed out that, generally, the motive-power used in this State is old in design and wasteful; and in considering this part of the question, it recalled to his (the speaker's) mind that he had once read an article in an American paper, wherein it was stated that nine out of every ten engineers would consider a plant highly economical and efficient if it had a compound engine. Frequently, however, such a plant was not so efficient as one might think.

Efficiency in the operation of a plant depended more on the proper arrangement of the parts and the distribution of their work, than on the correct design of the separate machines, and would only approach a maximum when all the parts were economical and when the full energy and the fixed charges of capital and labour were reduced to a minimum. These were points which might be thoroughly understood, but could not always be applied.

One would naturally think that, with economical parts, little fuel energy would be wasted; but it had been proved, and in America too, that a large plant, with triple expansion engines, equipped with all modern appliances, including feed-water heaters, economisers, condensers, etc., utilised less than one-third of the heat energy transmitted from the coal to the steam, while an isolated plant, with a small 50 h.p. engine, using low pressure steam in single cylinder only, with no condenser or expensive appliances, but with a correctly-designed heating system, utilised two-thirds of the heat energy.

There appeared to be something in the paper that pointed to the question as to what our accomplishments should be, to bring us up to the times as engineers; and taking this in the fullest sense of the term, one would almost think that it applied to specialists, and most people were a little afraid of the expression "Specialist Engineer."

It seemed to him that strict economy in production did not always follow with economy at the motive power end.

In the application of mechanical stoking appliances, economy of fuel is not the most important consideration; the question of labour-saving was a much larger item, and amounted in some cases to as much as 50 per cent. The economy of fuel results not solely or chiefly from prevention of smoke, but from uniform feeding of green coal to the furnace, entirely avoiding the opening of fire-doors, with consequent drop of steam pressure, &c. The advantages and economies—such as prolonged life of boilers due to regular firing—were claimed by most makers, and