

knew that when they got older, generally speaking, they had less vigour, but it did not follow that the canes were deteriorating. It was the ratooning system that was at fault. When the cane was ploughed out and replanted the same vigour was gained as when originally planted.

Mr. Mortifee stated that in his experience there was no deterioration. There was a plant cane on his land to-day as vigorous as he ever hoped to find cane. Where it was found to be languishing there must be something wrong with the planting or the soil. The cane had the same vigour in his experience as when he started, some nine years ago. As regards the planting of cane on the flats, the whole trouble was drainage. If you have a vigorous plant and it has wet feet, it lacks proper percolation of air through the soil and leads to deterioration. He had practically cut such portions up into squares at his farm. He had cut a drain about three feet, and they are all connected with each other. During the winter the whole of these drains are bone dry, with the result that the cane has a tendency to mature more rapidly than otherwise. With regard to the sucrose percentage, so far as his own figures were concerned they were something over 13 per cent.;

last year they were just under 13 per cent. With proper cultivation and drainage he saw no reason why they could not produce good cane.

Mr. Piccione stated that the elevation of Sea Cow Lake, referred to by Mr. Townsend, was much lower than the flats he spoke of; the Umfolosi flats also were much higher than Sea Cow Lake. All the land at Umhlatuzi was not marshy; there was only a small proportion of the flats that were marshy, and cane had hardly been tried there.

Mr. Anderson stated that it was rather important that their views on deterioration should be made clear. Arising out of the remarks of the Commission there was an article in the "International Sugar Journal" on the question, which might give the impression that cane growing in Natal and Zululand was almost a decaying industry. He considered it should be made clear that in the opinion of the planters present there is no sign of deterioration where the cane is properly cultivated.

The Chairman, in thanking Mr. Piccione, stated that it was very necessary that the question of growing cane on the different soils should be thoroughly discussed, and he hoped that next year they would have more papers by planters giving their experiences than they had had this year.

Economical Aspects of Lubrication.

(Paper by Mr. M. McMASTER, Director, Sir J. L. Hulett & Sons, Ltd.)

Some time ago I was requested to raise the question of the purchase of lubricants at this Conference. Since then the Organising Secretary has arranged that I should read a paper on the Economical Aspects of Lubrication, and kindly informed me of this when arrangements had been made.

I hope the following notes will lead to some discussion and be of some help to a more careful study of economical lubrication in the sugar factories.

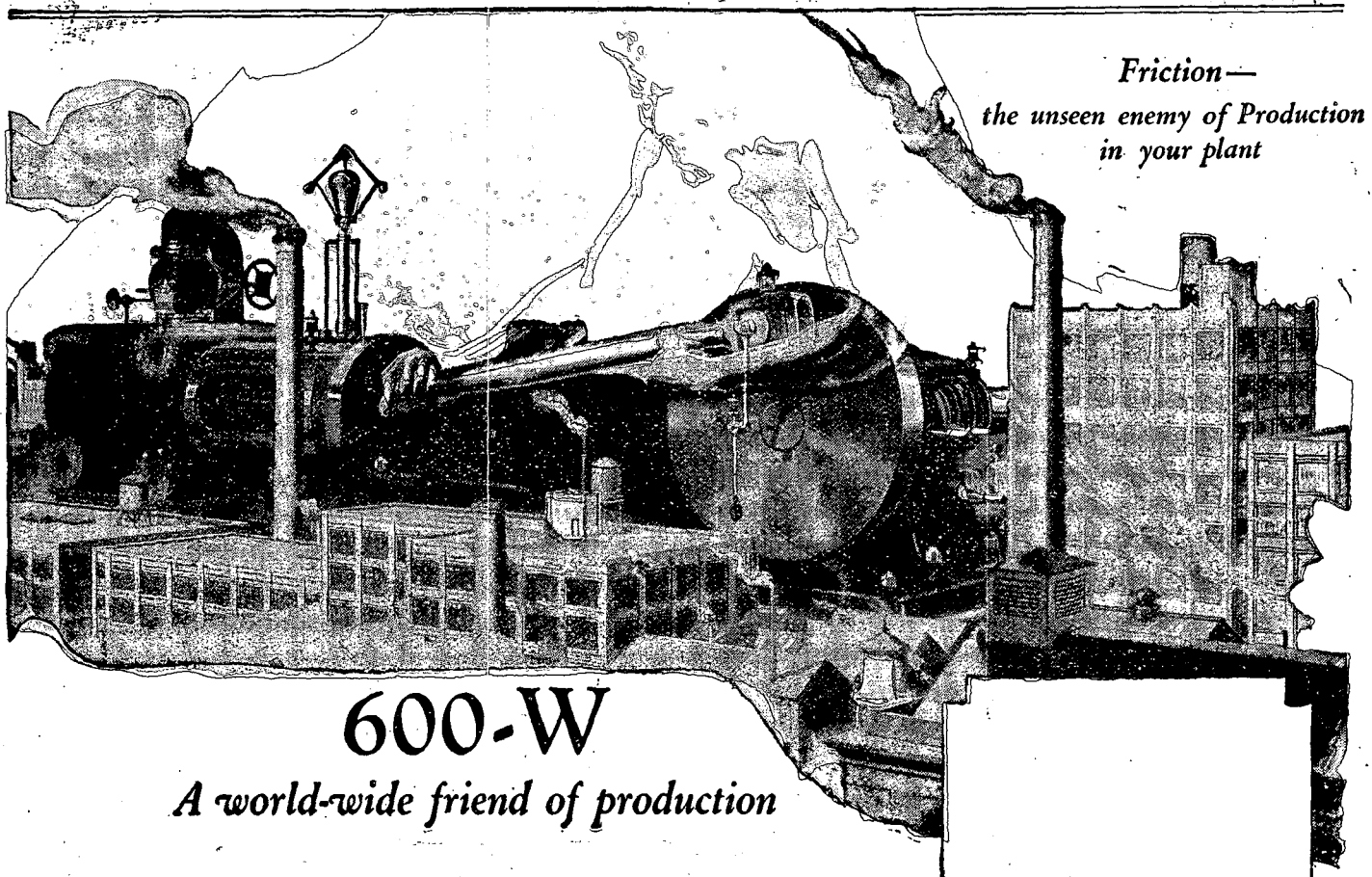
The question of economical lubrication is a very big question. There are very many diverse opinions on lubrication, and I think I am safe in saying that most of the knowledge of lubricants lies in the hands of the big oil companies, and for that reason we are rather in their hands.

From information gathered, lubrication throughout the sugar industry is a very big item of expense, probably reaching £40,000; it is also an extraordinarily variable one, I am informed, ranging from as much as 5d. per ton of cane crushed at some mills

to 1d. per ton cane crushed at other mills. It is obvious, with such variable costs of lubrication and unknown costs of repairs, caused by inefficient lubrication, that the expenses can be, in most cases, reduced by careful attention and a common sense study of the problem.

The whole economic aspect of lubrication comes down to this: the minimum amount of money spent on lubricants consistent with the minimum amount of repairs to machinery necessitated by that lubrication.

Let us now consider lubricants themselves for the moment. Lubrication is to interpose a film between two metallic surfaces to keep them from actual contact, thereby reducing friction and consequent ill-effects to a minimum. Although many substances are lubricants, a special class of substance called oil is found to be the best in practice. These oils are divided into three classes, animal, vegetable and mineral, but for our purposes the mineral oil class



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is the only one we need consider, although the other classes are used in the industry in a very limited way.

Mineral oils are manufactured from the crude petroleum obtained from oil wells by a process of fractional distillation, followed by treatment with various chemicals, and many are then filtered through animal charcoal. Some crudes, however, are practically pure hydrocarbon and only require separation by distillation.

Spirits, Petrol, Illuminating Oils, Lubricating Oils, Fuel Oils.

Generally speaking, the processes of manufacturing oils are kept secret by the firms.

The main conditions to be fulfilled by a good lubricant are roughly as follow:—

Body enough to prevent the surfaces coming in contact with each other; minimum co-efficient of friction; high flash point; ability to maintain its lubricating value within a reasonable range of temperatures, with no extreme variation in viscosity and impurities; perfect freedom from acids.

The economical control of lubrication can be divided into three categories:—

1. Purchase of oils.
2. Storage and distribution.
3. Efficient application.

Purchase of Oils.—I think it is well for us to always realise the seller is never a philanthropist; he is bent on business, or, in other words, out to take your money, and in the oil business generally, has the upper hand of the purchaser, owing to the latter's unfortunate lack of knowledge of oils. The oil man sells and knows what he is selling, and, consequently, we must get into the position of buying and knowing what we are buying.

I think one can divide the purchase of oils up into three different headings:—

- (a) Brand System.
- (b) Controlled System.
- (c) Purchase on Specification.

Purchase on Brand System.—This system is the commonest of all purchasing systems, and, in my opinion, in many ways it is unsound and puts the purchaser into the hands of oil-supplying firms. Cases have occurred where jobbers have found the market, bought low grades in from a big firm, mixed them, branded them with a special brand, and have made a very large profit and supplied a very poor article. Although there is no doubt some well-known brands on the market to-day are sold simply on their merits, we have no guarantee that the oil is kept at a fixed standard, and no guarantee that we are getting value for our money. Fundamentally, such mystic signs as "Cylinder 17 D," "Special T.E. 17," etc., are purely for the use of the seller, and they

should theoretically have very little weight with the engineer. I think it should be realised that it is very rare in some sugar mills that sufficient careful checking of oils as regards lubrication results is kept, both practically and financially. This means that, in many cases, it is not known whether a particular brand is really economical or not. The purchase by brand system also leaves a loophole for several other serious evils, which are quite obvious, but which I do not intend to discuss.

Purchase by Control System.—I use this name to embody any other system of purchase than brand and not on specification; it may be some arrangement where the oil-supplying firm supplies a minimum quantity per month on certain terms, or has some sort of control of the lubrication at the mill. Personally, although I know many differ from me, I believe that a system where the oil-supplying firm will take over and run your factory for you, for a specified period, and show you what they can do in the way of decreasing your costs, is a very sound method of purchase. The different oil-supplying firms could take over different mills, publish and compare results, and this would set up a very keen competition, which means, and which is very important, that the oil company having charge of the lubrication of your factory would always be attempting to improve the method of application, and they are the people who have the knowledge to do it. There are one or two objections to this system; in the first place the oil-supplying firm and the engineer must be able to work together—this, of course, is a personal matter, but in some cases perhaps a rather difficult one to get over; in the second place, not all the big oil-supplying firms have the technical assistants who could supervise the work. As a matter of fact, it is rather absurd to think that the oil supplies are being bought from firms who have not got any technical staff on the spot.

Purchase on Specification.—Purchase on specification is very widely practised by all big concerns, such as the British and American navies, and big railway companies. It is well to realise that, although this is an excellent recommendation for the system, we have not the same knowledge in a smaller industry, and to purchase on specification requires a careful study of the theory of lubrication. One of the chief difficulties of introducing this system is that little is known of the present oils we are using, and the satisfactory oils in use at a factory would have to be analysed and a corresponding specification drawn out. Working on this basis it may be quite possible for the engineer, in a very short time, to get acquainted with the necessary physical tests and requirements and could gradually improve on his specification until he finds he has got what he has been looking for. It must be borne in mind that

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practical results must work in harness with specifications. Oil-supplying firms who seem mostly against buying by specification, maintain that two oils with identically the same specification may act on a given plant entirely differently, one lubricating the plant efficiently, and the other ruining it; this being caused by the different crudes. However, by co-operation with the oil-supplying firms, and the use of a practical oil-testing machine, which defines the actual lubrication value of the oil, this difficulty should not be a hard one to get over. With an oil-testing machine the oil can be tested under any condition of metal surfaces, temperature, speed and pressure, which is a fairly practical test of the oil on the condition under which it is required.

The most important items in specification, leaving out the many intricate tests which are of very little assistance to the practical engineer, are viscosity, with a fairly wide range of temperatures, loss by evaporation (working at high temperatures in cylinders, etc., a considerable quantity of oil is evaporating off, which is a dead loss), freedom from acids and impurities, and flash point. This latter does not affect the lubrication qualities but is naturally a safeguard in the factory against fire.

These tests are all fairly simple and, except in the case of the oil-testing machine, not much apparatus is required. Of course, the great advantage of this system of purchase by specification is, that it brings in open competition of all oil-supplying firms; the engineer knows his oil intimately, and knows that it must always be kept up to standard, and it takes away that impression that we are in the hands of the supplying firms.

In summing up these different methods of purchase I feel sure there will be many differences of opinion. Although rather favouring a system where a firm take over the mill for lubrication and have to prove themselves by financial results, it is probably only by practical experience of different systems that the best can be discovered.

I hope that gentlemen present will give their own practical experiences.

Storage and Distribution.—I think everyone will agree that the proper storage and organised distribution of lubricants in a sugar mill is one of the most essential points in economical lubrication. The lubricants should be kept in the mill store, under the charge of the storeman. A ready use store should be fitted in the mill in as convenient a position as possible, containing storage tanks of definite marked capacities, each containing the various types of oils and each type being clearly marked on the tanks. The chief engineer should have a list showing the allowance, per diem, to each unit in the factory. The chief engineer should make a monthly requisition

from the stores, the shift engineer supplementing this with a daily requisition. At a given time during the day the greasers responsible should be issued their daily allowance for the various units under their charge for lubrication, under the supervision of the shift engineer. Every precaution should be taken to keep the oil scrupulously clean until in the lubricator or bearing.

In the event of any oil, in excess of the allowance, being required for hot bearings, or any other urgent case, the allowance should be made by the shift engineer, who should immediately report same to the chief engineer. By this method a careful check on the daily and monthly distribution of oils is kept, and accurate entries made for each unit in the factory, and once the allowance is made for each unit, by careful studying of the lubrication of individual units, the allowance can gradually be brought down until it reaches the critical state. Only then can the factory be said to be economically controlled.

In many concerns a supervisor of lubrication is a special appointment. It carries with it the complete responsibility for lubrication throughout the factory. In a big mill this post would be most useful, and the wages for the man would be much more than covered by the saving in oil bills and repairs.

In dealing with the last part of these notes, which I called Application, it is convenient to divide this into three headings:—

- (a) Choice of lubricants for various mechanical parts.
- (b) Actual method of application.
- (c) Recovery and filtration.

(a) The efficient working of machinery is very largely due to the right lubricant, and it is only by the very close attention given by the engineer that this can be selected. It is quite impossible to lay down any hard and fast rules for selection of lubricants, but there are certain principles that may be followed.

For low speeds and heavy pressures a heavy-bodied highly viscous oil should be used.

I am informed that there is a mill running with grease cups on all its bearings in the train of wheels, including the crank shaft of the main engine, and there has been no overheating, and the bearings and journals found to be in excellent condition at the end of a fairly heavy crop.

For high speeds and light loads a light-bodied oil giving a thin film is suitable.

For cylinder lubrication an oil that will atomise easily and stand up to high temperatures and pressures. Cylinder oils are usually compounded oils, and the pressure of fatty oils enables the oil to stand up to the high temperatures. It should be a fairly

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heavy-bodied oil, and in practice the addition of graphite, which fills up all pores of the cylinder walls and gives a glassy surface, is often used.

In the lower pressures and temperatures in a sugar factory it is essential to keep to pure minerals if there is any danger of fatty acids finding their way back to the boilers.

(b) Application of Oils.—The principle underlying the application should be to spread a film of oil of the lowest viscosity completely over the bearing surfaces which remains at all pressures and temperatures. To enable this to be done there are many different forms of lubricators, sight feed lubricators, forced feed lubricators, oil cups, centrifugal lubricators, splash lubricators, etc., and many others.

In the case of the ordinary bearing and shaft, which is probably the most important, the point of maximum pressure should be found and oil applied before this point. The oil is then drawn round the shaft. It is quite frequent that oil is applied at the point of maximum pressure—usually none can enter the bearing at all. The oil should be applied so that it will stay in the bearing as long as possible, therefore the principle of the oil bath should be followed where possible.

So far as we are concerned in the sugar industry, one of the big oil companies has, I believe, thought out a system of forced lubricator application to many parts of the factory, which is certainly a progressive step, and I am sure we would be very interested to hear of the practical results of this system by any gentleman.

For the application of grease the ordinary tell-tale grease cup has proved very efficient in the case of the mill with train of wheels all lubricated by grease.

This question of application is a very wide one, and one of the many different ideas and methods, and again, when the first principles have been carried out, a matter of practical results in the form of £ s. d.

(c) In a sugar factory, where one might say the conditions are not suitable for tight bearings and small clearances, it is quite obvious a very large amount of oil goes through the machinery without being hardly used, and in many cases is then thrown away. I believe this to be one of the biggest wastes. It means the engineer is apt to economise too much in oil, knowing that oil is lost. A system of return feed, where the oil may be used for a long time, provided it is filtered and allowed to settle to remove dust and metallic particles, may mean a considerable saving. It is an inducement to use the highest grades and best oils, and no necessity to spare the oil too much. I am informed that this has been tried and is in use in the industry and has proved of con-

siderable value. The oils are usually, in any case, fit for rougher and less important uses, such as workshop, shafting, pumps, trucks, etc.

To sum up this question of lubrication it is only by constant attention and a very careful costing in all the different units and departments of the factory that really economical control can be exercised. We must endeavour, by some of the methods described, to get more or less out of the hands of the oil-supplying companies and make them compete for our business. Not only should lubrication be looked upon as a necessity in engineering, but as an absolute part of the machinery itself. Efficient lubrication means longer life, less repairs, less power used and lower expenditure in the long run, which is the ultimate object.

My own experience in sugar is a very short one, and these notes are made only with the object of raising this question of lubrication, which I was asked to do.

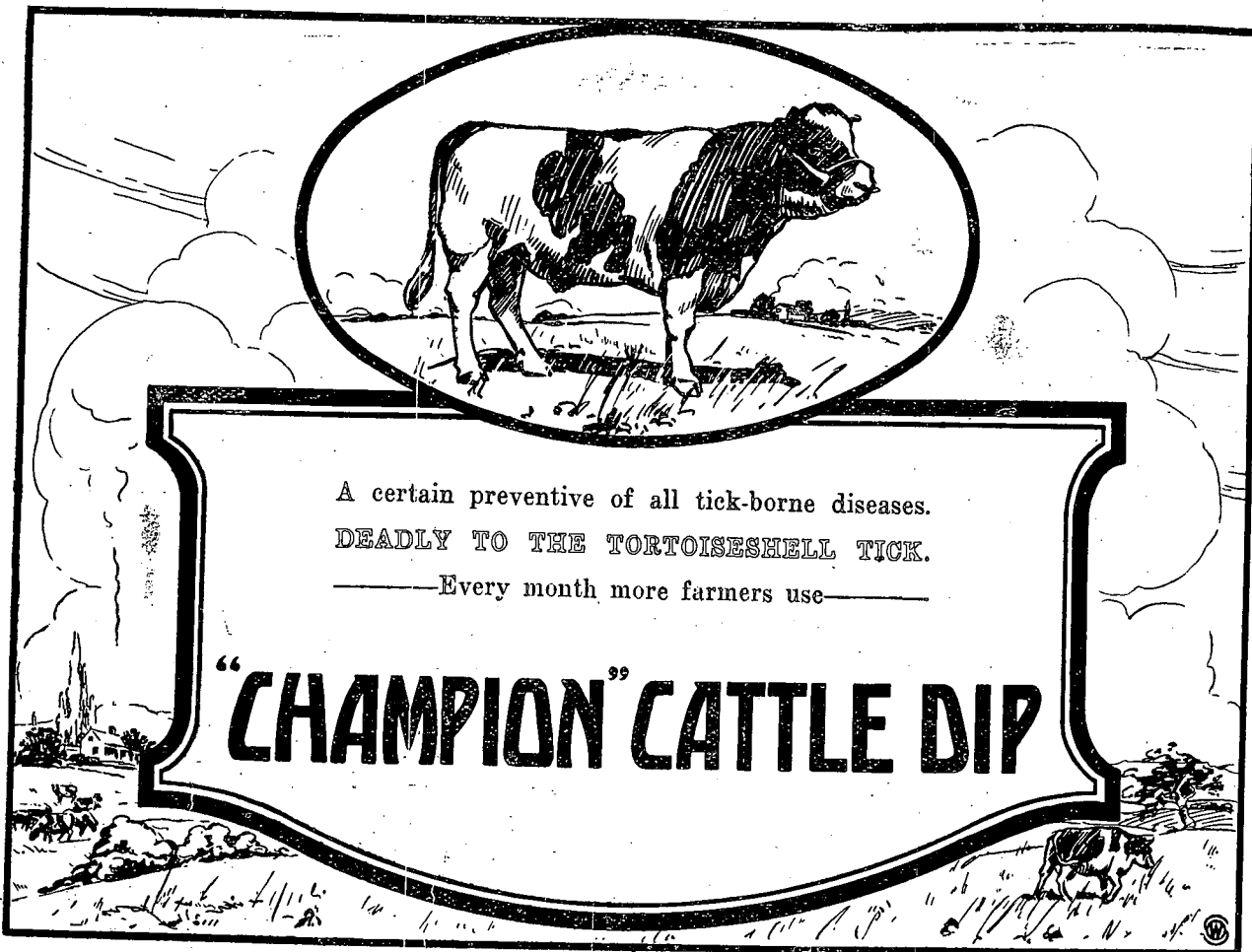
In conclusion, might I ask some of the gentlemen present to give us their practical experience in the sugar mills, which will be of very great interest to us all, and these expressions of opinions and exchange of ideas will be of untold benefit to all concerned in this most important and rapidly growing industry.

DISCUSSION.

Mr. Murray stated that they were all obliged to Mr. M'Master for his paper. He suggested that next year a committee be formed for the purpose of drawing up the papers required, and that these papers be circulated so that they would get better discussion on them.

Mr. Malcolm complimented Mr. M'Master on his paper, and stated that some time ago his company was purchasing oils by brand, and their oil bill was a fairly big item. He had a visit from a gentleman who at one time held the appointment of lubrication engineer for the Panama Canal, and he asked if he might be permitted to look around the factory. After going through the refinery, this gentleman told Mr. Malcolm that he could save him about 75 per cent. of his oil bill, and asked permission to place a man in control for one month, and told him he would be able to produce facts and figures and supply oils that would give them the above saving. As Mr. M'Master has said, the personal element often comes in. A lubricating engineer was sent along for one month, but owing to the personal element the engineer in the refinery thought it was a reflection on him. That was entirely the wrong view to take of it, and after a little talking he rendered what assistance was necessary to the expert who came in.

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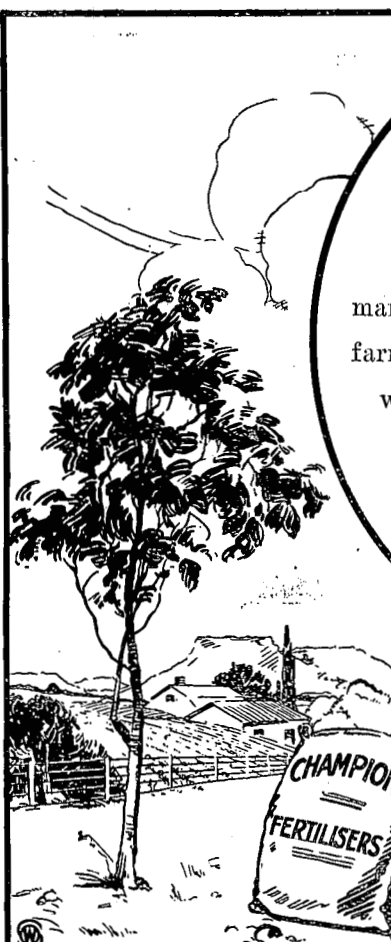
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During the time it was under control, that expert showed a saving of 25 per cent. At the end of a year's working under these conditions they had a saving of about a penny per ton of sugar manufactured. They bought the oils specified by him. The great difficulty experienced prior to that was that the people selling oils were not very definite in their answers to the questions put to them. It would be a step in the right direction to have a control period for a specified time by given suppliers of oils. The trouble is that they have not got engineers with expert knowledge to give their experience here. There are one or two companies who have experts in lubrication, and if the millers could avail themselves of that expert experience it would show a considerable saving in the costs of lubrication.

Mr. W. P. Tucker stated that in the factory he was connected with they used grease in every part, with the exception of high-speed dynamo shafting.

Mr. H. Armstrong considered that it was not necessary to get the oil companies to send experts. It was the duty of the engineers. Each engineer should be competent to control the oiling. That system had been carried out at his factory, with the result that they had reduced the lubrication cost from $2\frac{1}{2}d.$ to $1\frac{3}{4}d.$, due to the work of the engineers alone.

Mr. Malcolm stated that in the Old Country, where there is a considerable amount of lubrication required, they have a supervisor, a man who is responsible for the oiling of the plant. He sees that the quantity of oil is issued, and that it is properly applied. We may have cheap labour in the Indian,

but until we have Bowser tanks with a graduated gauge, there should be white supervision. It would pay the mills and refineries to appoint a white supervisor to look after the lubrication. The saving effected would more than pay for the wages of such supervisor.

Mr. Wilson, in congratulating Mr. M'Master, referred to the wastage of oils. During a voyage from Scotland to London, they passed a very palatial dwelling standing on the coast, and on enquiring from the chief engineer he was informed that it belonged to Colman of mustard fame. He remarked that there was evidently a lot of money in mustard, when the reply was made that it was not the money that was made from the mustard that is eaten, but what was left on the plate! The same thing applied to oil; it was not the money lost on the oil used, but on the oil wasted. At the refinery he was connected with, in 1920 they put in a filter to deal with waste oils. Their consumption was about 150 gallons of engine oil, 30 gallons of cylinder oil, and 100 lbs. of cup grease. After collecting the waste and filtering it, the consumption dropped in 1921 to 88 gallons of engine oil and 20 gallons of cylinder oil per month, which was a very big saving.

Mr. M'Master remarked that on the Windsor Castle, which has a colossal quantity of machinery, they had got the return system to such a fine art that the total quantity of oil used was somewhere about six gallons per day.

The Chairman thanked Mr. M'Master for his very interesting paper.

Labour Rations from the Economical Aspect.

(Paper by Mr. S. B. EDWARDS, Buying Department, Messrs. David Fowler & Co., Ltd.)

The Natal Coast Labour Recruiting Corporation has recommended a food scale for natives, which has, I believe, been brought to the notice of everyone concerned. The question of rationing is one of the greatest importance, and one to which special attention should be given. Wrapped up with this is the economical side of the purchasing of the rations to be distributed. This necessitates advance knowledge of requirements, and careful watching of the markets, both here and overseas, as supply and demand are serious factors.

Under normal conditions contracts are recommended, but should be placed when the markets are easy and in full supply, not early or late in a

season. Export trade is growing and is commanding the serious attention of the farmers, and your costs here are mainly governed by this.

This season's crops are expected to be very large, and are some three or four weeks earlier than normally, and reaping of maize will be accelerated on account of the high prices ruling.

Outside of contracting, it is perfectly feasible to buy direct from the growers in bulk in the early and mid-season periods, but this entails storage facilities and some considerable outlay, as terms are cash against rail receipts; this is therefore more a question for the consideration of the big consumers. With forward purchases of this nature it