JOURNAL AND PROCEEDINGS OF THE

INSTITUTION OF AGRICULTURAL ENGINEERS

VOL. 16 NO. 3 - JULY 1960

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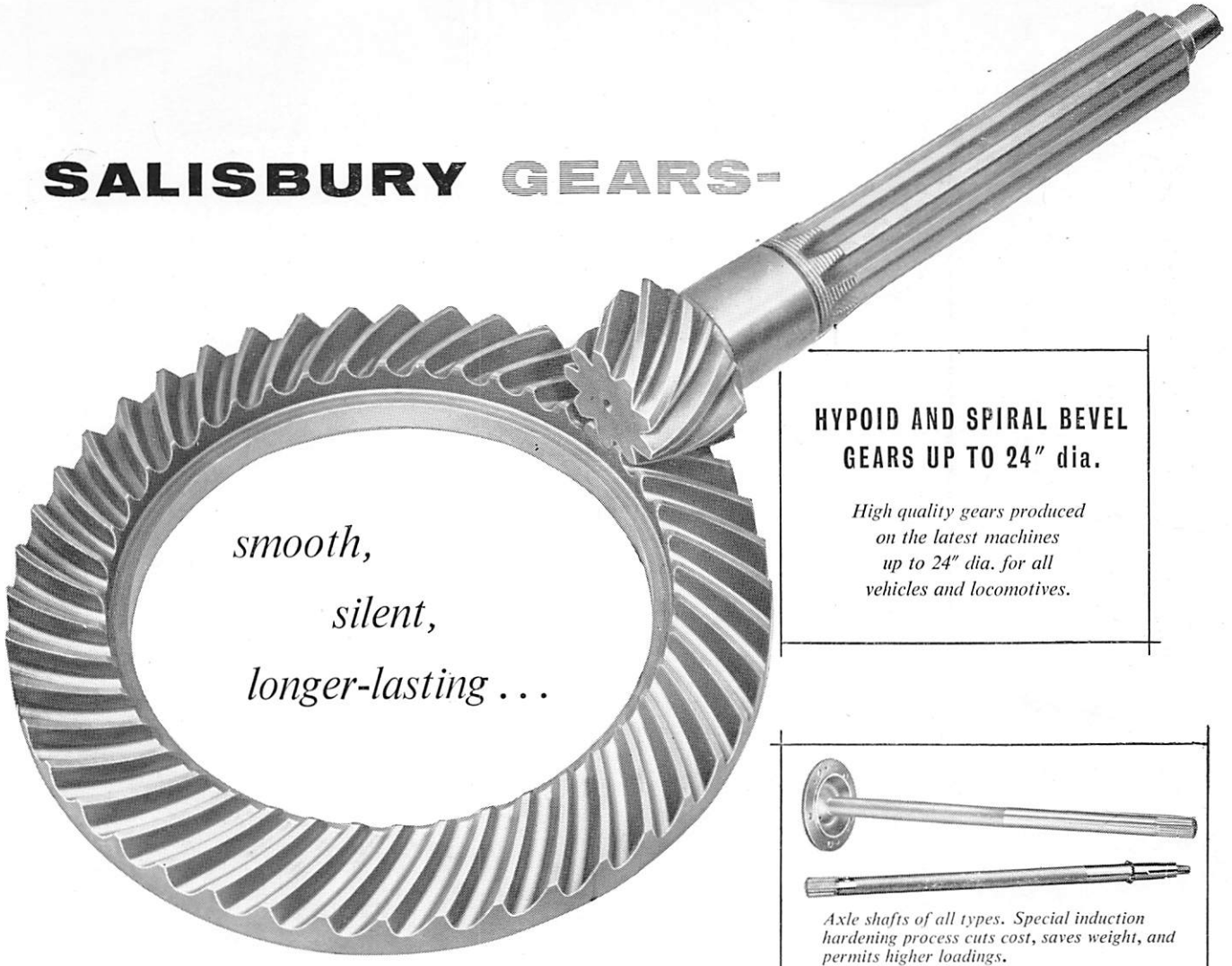

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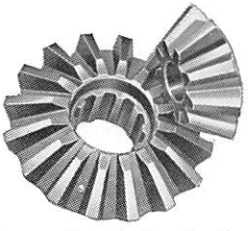

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JOURNAL AND PROCEEDINGS OF THE INSTITUTION OF AGRICULTURAL ENGINEERS

VOLUME 16 - NUMBER 3 - JULY, 1960

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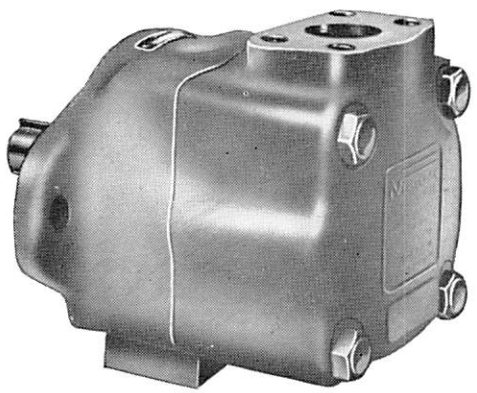

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INSTITUTION NOTES

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National College of Agricultural Engineering

A MEETING of the Board of Governors was held in June last, when the first steps towards the establishment of the College were taken. An Academic Committee, Building Committee and Finance Committee were appointed, and the Building Committee has already met on the site of the College. The Institution's representatives on the Board, Mr. Alexander Hay, Mr. D. R. Bomford and Mr. J. M. Chambers, are serving on the Academic, Finance and Building Committee respectively.

The positions of Principal and Bursar have been advertised.

Institution Examinations

The examinations for the National Diploma in Agricultural Engineering and for Graduate Membership of the Institution were held in July at the Essex Institute of Agriculture. Lists of successful candidates appear on pages 65 and 82 of this issue. In the opinion of the examiners the standard attained by Diploma candidates was an improvement on the average of previous years, with the result that the proportion of passes was 77%, with eight men gaining second class honours. None, however, reached the standard required for the award of the Johnson medal, this requiring "outstanding merit" in the examination.

The results of the Graduate Membership examination were not so satisfactory, but as this is only the second year since its inauguration it is felt that this result is understandable. When courses of study have achieved a more uniform pattern there is little doubt that this avenue into membership will reach a pass standard comparable with the Diploma results.

Membership Certificates

Copies are now being sent to members who have applied. Other members are reminded that Certificates may be obtained on application to the Secretary, unframed free of charge, or framed at a cost of 15/-.

Branches

With the continued increase in membership, the Council has again considered the advisability of establishing a Branch in the South-West, and has decided that, subject to the necessary support being forthcoming, it is now opportune to do so. All members living in the area (Cornwall, Devon and parts of Somerset and Doreset) have been written to, and it is likely that an inaugural meeting and dinner will take place later in the year.

Annual Meeting 1961

Following upon earlier consideration by the Council, and discussion at the Annual General Meeting this year, arrangements are now in hand for the Annual Meeting in 1961 in London. The provisional programme is: Annual General Meeting, Paper, Luncheon (informal), Forum, Paper, Dinner, with coffee and tea breaks. Full details will be announced in due course.

The Council has decided to revert to the practice of new officers and members of Council taking office immediately after the Annual General Meeting instead of in October, as at present.

Mr. W. J. Priest

The Council learned with pleasure that Mr. Priest, a Vice-President of the Institution, has been appointed Editor of *Farm Implement and Machinery Review*, an old established and respected journal, for many years under the control of Mr. Roger Wilding and recently acquired by the publishers of "The Engineer." On behalf of all members of the Institution, good wishes have been conveyed to Mr. Wilding upon his retirement, together with an appreciation of all that he has done for the agricultural engineering industry.

SPEECHES AT THE ANNUAL LUNCHEON

Held at the Piccadilly Hotel, London, W.1, on 9th May, 1960.

MR. W. J. NOLAN (the President of the Institution) was in the chair. The Loyal Toast having been honoured, the President said : I have great pleasure in introducing our guest of honour, Sir Harold Roxbee Cox, and other principal guests to you on this very special occasion. An eminent scientist, as well as an eminent engineer, Sir Harold is one of the country's leading industrialists, but, despite his many activities, he still finds time to foster the advances of applied science. We are particularly happy to know that he is now Chairman of the National Council for Technological Awards. The important work of this body is of great interest to ourselves.

The Institution is glad that Sir Harold has been able to join us on what we regard as a memorable day. This Luncheon brings to a conclusion the 21st anniversary year of the Institution. Much of lasting importance has happened during this year, and as the Institution advances its members will look back on the 21st milestone as one of the most significant landmarks in its history. For this reason alone it is stimulating to have such a guest of honour as Sir Harold and to see among such a distinguished and pleasant company all the Past-Presidents of the Institution. They are all here. [Applause.]

We are also delighted that Sir Gilbert Flemming, Chairman of the Board of Governors of the National College of Agricultural Engineering, has been able to come, with several of his fellow Governors. The idea of the establishment of a National College was first put forward by Mr. David Ransome, then President, at a luncheon held by this Institution five years ago, and it is a project which is dear to our hearts. We wish to assure Sir Gilbert and his colleagues—Mr. Buscombe (Director of Shell Mex), Mr. Frank Appleyard (of the National Farmers' Union) and Mr. Batty (Manager of the Tractor Division of the Ford Motor Company), who was to have been here, but has been suddenly called away, as well as Captain Griffith (Chairman of Rotary Hoes)—that this Institution will always be ready to help them in any way it can in the fulfilment of the aims of the College.

We are graced by one of the most distinguished gatherings it has been our pleasure to entertain. It is an honour for me as President to ask Sir Harold to propose the toast of the Institution.

The toast " The Institution of Agricultural Engineers " was proposed by Sir HAROLD ROXBEE COX, D.Sc., Ph.D., D.I.C., M.I.Mech.E., F.R.Ae.S., F.Inst.E., Chairman of the National Council for Technological Awards, who said : May I first congratulate you, Mr. President, and your Institution on your coming of age. When I came here to-day I had not realised that you were to-day 21 years old. I know that you invited me here because you are deeply interested in education, and you know that I, as Chairman of the National Council for Technological Awards, must be interested in education, too. Indeed, at first I thought that that was the only link between us, but I have come to the conclusion that there are others. In fact, with a little indulgence on your part, I believe that I could almost be regarded as an agricultural engineer.

At present I am concerned with three different industries. One of them, the automotive industry, can, I think, by common consent be regarded as agricultural engineering, because it makes tractors and all sorts of associated equipment. The second, the aircraft industry, makes aircraft and helicopters which spray crops. They, too, seem to be agricultural engineers.

The third of my industries, the package-making industry, in which I spend most of my time, cannot, I fear, be described as agricultural engineering, but when I consider the complex engineering which goes into putting packets of plastic, metal and paper around agricultural produce which you have much to do in producing, I think that we ought to be regarded at least as honorary agricultural engineers. You and I, besides having a common interest in education, therefore, have a number of other points in common ; perhaps in all seriousness they are a little tenuous, but at least they give me sufficient understanding of your outlook for me to have the greatest sympathy with your efforts to delimit agricultural engineering as a branch of engineering and to seek for it educational standards as high as the highest in that profession.

To reach that standard you decided quite a long time ago that, in addition to all that you have done in the establishment of the National Diploma in Agricultural Engineering, you should have a National College of Agricultural Engineering. I am quite sure that you were right. I understand that that great plan is nearing fruition. As Chairman of the Board of Governors, you have an old friend, Sir Gilbert Flemming, who, first as Deputy Secretary and later Permanent Secretary of the Ministry of Education, was of the greatest help to my colleagues and myself in the development not only of the manifestly successful National College of Aeronautics at Cranfield, but also of the National Council for Technological Awards, of which I am Chairman. I am sure that under Sir Gilbert's guidance the plans for your new College will go forward with the utmost expedition. Of one thing you may be sure—he will stand no nonsense from the Ministry of Education ! [Laughter.]

I rather envy him and his colleagues the task to which they are now setting their hand. I do not know how long it took them to decide upon the site of the college, but I must congratulate them on their choice, which I think is very significant. Those of us who know something of the National Institute of Agricultural Engineering at Silsoe know how valuable its proximity to the College will be. It would be presumptuous of me to suggest how full advantage should be taken of that proximity. A great deal of thought will have to be given to that, if it has not been given already, but the advantage offered to a National College of Engineering by being next door to an engineering research and development establishment are to me obvious, and, I think, to you too. Whether Mr. Cashmore will permit any of his staff to lecture in the College I do not know, but I sincerely hope that he will. Whether he will be able to use College students as assistants in his establishments as part of the College course I am not able to tell, but I hope he will. I feel that you have through this contiguity an opportunity which you will not miss. It might be a unique opportunity.

The idea has probably been in many heads for a long time that a close association between a research and development establishment on the one hand and a place of learning on the other hand could be advantageous, but I cannot recall that this has been seriously tried out. I think that you will have a chance with your new College of proving the advantage and, indeed, of pioneering a new kind of partnership in the educational field.

The other partnership to which one must offer a genuine tribute, I think, is that between the Ministry and the agricultural engineering industry. The Ministry, I understand, will stand the cost of building and of maintaining the college while the industry has undertaken to sponsor students and to provide all the necessary equipment. I think that that is splendid. It must be encouraging for the promoters of this great plan to know from the outset that the agricultural engineering industry is behind it.

I mention that particularly because the many branches of the engineering industry have not been uniform in their support of academic ventures designed for their benefit. It has not been unknown in the past for their reception of a proposal to provide a large number of scientifically trained staff to be lukewarm. In fact, our engineering industry is rather uneven. In its organisations many are world leaders, but some are not ; some are behind. Some of its organisations employ to their mutual advantage large numbers of scientists and engineers, and there are others—and I am not thinking only of small firms—in which the number of graduates, scientists and engineers is extremely small. In those organisations, I think, there is still a suspicion, even in this day and age, of the scientist, who is visualised as an individual with rather long hair, with a somewhat farouche appearance and with starry eyes shining through rather thick glasses. One might have wondered, had one not stopped to think, whether the engineering side of the world's oldest industry was not hampered by some sort of tradition and superstition. But it is delightful to find—and the evidence is there for all to see—that it is, in fact, on the side of the angels, and when one remembers its origin in the Garden of Eden, I suppose that is not surprising. It might be surprising that these scientific angels are of the crop-spraying type, but there it is. You have obviously concluded that you must have more and more of these people.

When one considers the opportunities for agricultural engineering at home and abroad—opportunities which you have taken to great measure, but a great deal of which remain to you to take—one can only say how right you are. You will want lots of people which this College can provide. I have recently been in India and other Far Eastern countries, and the need for agricultural equipment adapted to their particular local needs is manifest. I feel that by the time you have this College finished you will begin to formulate plans for its expansion.

I look at the whole project with a kind of professional educationalist's eye. I am quite sure that there will be post-graduate courses in your college, and I am quite sure that in this the College's next-door neighbour will play a very important part. I am quite sure, too, that the majority of the students of the College will be aiming for an award of graduate standard—probably an award of honours graduate standing—and there seem to be three clear possibilities in that connection.

There is the possibility of the College setting up an award entirely of its own without reference to what exists elsewhere. There is the possibility of it associating with some university or college of advanced technology and collaborating in their award. And there is the possibility of the college seeking recognition for its courses from the National Council for Technological Awards and thereby creating a Diploma in Agricultural Engineering. I could point to the advantages and disadvantages of each of these possibilities, but I will refrain from doing so.

I have talked so much about your College, your great project, that I have left no time to talk about you, the Institution of Agricultural Engineers. But I feel that you, like me, have most prominently in your minds on this occasion the College which you see shimmering in the mists of the immediate future, and it is as the authors of it that I salute the Institution to-day on its 21st birthday and invite you to drink a toast to its future welfare. I give you the toast of " The Institution," coupled with the name of its President.

The PRESIDENT, in response, said : Like all your listeners, Sir Harold, I was extremely interested in the points you made in your speech, and I have much pleasure in thanking you, on behalf of the Institution, for the charming and effective way in which you have proposed the health and prosperity of the Institution.

There is no doubt that what you have said will inspire us to achieve greater things. It certainly stimulates me to appeal to all who represent agricultural engineering, and, in fact, to any whose work is allied to agricultural engineering, to help build the strength of the Institution. This can be done in three ways. Firstly, by encouraging suitably qualified members of their staffs to apply for membership of the Institution ; secondly, by encouraging companies to apply for affiliation to the Institution ; and thirdly, by encouraging the recognition of the

National Diploma in agricultural engineering when vacancies in employment have to be filled.

The activities of foreign competitors are increasing and there is no room for complacency. Technical information and know-how are vital to the country and to our overseas markets. A number of leading manufacturers have already set an example by giving the Institution invaluable support and assistance. Let us go forward in the spirit which has symbolised our 21st anniversary year.

Three of our representatives on the Board of Governors of the National College will, I know, have received Sir Harold's comments on technical education and the College with satisfaction. These three—Mr. Bomford, Mr. Chambers and Mr. Hay—each played a conspicuous part in helping the Minister of Education to make up his mind on the national need for such a College.

During its first 21 years the Institution has achieved a number of objectives. One of them, which will be of great importance to our future development, is the grant of incorporation. It is our hope that this official recognition will eventually be seen to have been the first step towards our ultimate aim of the award of a Royal Charter.

Our 21st anniversary has come at a very interesting time in relation both to developments in British agriculture and in the agricultural engineering industry. Only five industries have exported goods valued at more than £100,000,000 annually, and no one must be allowed to forget that agricultural engineering is one of them. Undoubtedly, it stands on the threshold of even greater things, and, may I emphasise, this has exposed a defect which our Institution is determined to see remedied.

A leading company announced last week its plans to guild a new £10 million plant, and it is evident that the industry has every intention of surpassing its present records in overseas trade. This splendid example will, no doubt, be followed by others, and we can expect further expansion in the production of farm implements.

It is against such an enterprising background that we come to a sobering thought. Will the industry have a big enough intake of young people basically trained in agriculture and in engineering who can take their place in the design and development and production departments, in marketing research, in technical sales and in service departments ?

The answer to that question is—yes, once the National College of Agricultural Engineering is under way. I believe that the beneficial effects which the National College will have on the situation cannot be overemphasised. The College has long been seen by this Institution as the corrective to this problem. The Institution considers the acceptance of the principle of the establishment of the College as one of the most important steps undertaken in agricultural engineering since the war.

Recently the Council has been considering the work of the College in relation to the new and rapidly changing conditions in world trade. The threat of foreign competition is very real. I want to tell you that the view of the Council is that the physical development of the College is a matter of considerable urgency now that the site for it has been acquired.

May I also suggest that while we are awiting for the College to get under way the industry should seriously consider now the future of those who have been awarded the National Diploma in Agricultural Engineering. As many of you will know, this Diploma was inaugurated in 1951 by the Institution and from that time onwards the number of candidates has steadily increased.

The Institution is anxious to seek the wholehearted co-operation of every branch of agricultural engineering so that suitable employment can be found for Diploma holders. If it is not, I believe there is a danger that these young people may be lost to outside industries. I am sure we shall get that help.

As many of you know, on Wednesday and Thursday of this week the National Institute of Agricultural Engineering will be holding its Open Days. This is a most welcome occasion for visitors to see the kind of work that has made this research centre so famous. The Institution has received invaluable help from members of the staff of the National Institute in numerous ways. Sir Harold, with his pertinent remarks about partnership, left that thought very much in our minds. The Institution is most grateful for their help.

I am particularly pleased to be able to tell our guests that the Director of the National Institute, Mr. W. H. Cashmore, is one of our Vice-Presidents. Companies who are affiliated have also given us valuable assistance, and, likewise, I should like to refer to our good friends, the Press, who have generously given us their support for many years.

May I, on behalf of the Institution, thank all of them most sincerely for their help.

Equally, I should like to pay a tribute to the untiring efforts of the Branch Secretaries, who are the nerves and sinews of the Institution, and may I also include in that tribute the work of Mr. Slade and his staff, who have made this luncheon, and many other matters, such a success.

I now have the very pleasant responsibility of announcing the presentation of a gift to the Institution by past and present members of the Council, who wished to put on record their appreciation of the work of Colonel Johnson, our founder President. They decided that a portrait would be the ideal tribute to a very remarkable man.

The Portrait, painted by Mr. Russell Reeve, whom we welcome here to-day, is to be hung in the Council Room.

The picture is here, and by way of concluding a most pleasant occasion, may I, with your permission—and your permission, Sir Harold—ask Colonel Johnson to join me in making the formal presentation of this fine painting ?

The PRESIDENT then unveiled the portrait of Lieutenant-Colonel Philip Johnson, the Founder President, by Mr. Russell Reeve, and called upon Colonel Johnson to reply.

Lieutenant-Colonel PHILIP JOHNSON : I hope you will forgive me if I remain seated while I speak to you, as I was seated on several occasions when the portrait was painted by Mr. Russell Reeve, who has made a wonderful job of it.

I find it delightful to be here on this occasion, surrounded by innumerable friends. The subject before the assembly is myself. That suits me very well and I have no desire to change the subject. It panders to my egotism and it boosts my conceit, which is already colossal. When I was very young I inherited the egotism, and the blame for that can be laid only on my ancestors, and I do not suppose they mind.

The conceit is another matter. I think that I share the blame for that in about equal part with an American essayist, who was very well known in my young days—Oliver Wendell Holmes.

He said somewhere that conceit keeps a man's mind sweet and renders it pure. There were many outcries against that and many suggestions that a really conceited person was invariably a bore who deserved everything which could possibly happen to him. To that Holmes replied that, although he thoroughly enjoyed a dip in the ocean in suitable weather, it did not mean that he wanted to be pickled in salt for the rest of his life.

About the year 1936 I had two ambitions. The first of these—a minor one—was the establishment in the right place at the right time of an agricultural engineering exhibition, the right place being London and the right time of year being December. There was tremendous opposition to that, but it materialised, although in many ways not in the form I should have wished. There were several things about it with which I did not agree.

The second ambition, this Institution, is a different story altogether. To my mind, it has not a single blemish on it. I am not suggesting that it will not develop and expand and extend ; it has shown every indication that it will and can. I am confident that in the course of time, if I live long enough, I shall be able to look back with pride at the efforts I made originally in its establishment.

It must not be forgotten that nothing I did could have been effective in the establishment of this Institiuton had it not been for the band of enthusiasts—I will not name them for fear of forgetting one or two—who supported the idea of the Institution and saw it through all its initial teething troubles which it had in the early days. The Institution has come to fruition, and nothing could please us more than that fact. I hope that that band, most of whom are present here to-day, will regard the honours which the Institution has seen fit to shower on me as an appreciation of their efforts, as well as of any that I may have made. That band is entitled to the major part of the credit for seeing this Institution rise to its present situation, and I should like them to feel that whatever is accorded to me goes to them, too.

I do not want the impression to be created that I am in any way criticising the decisions reached by the corporate wisdom of the Council of this Institution. That would be presumptuous on my part and I should never think of doing it. It is a comfort for me to say that I can shelter under those decisions and accept the honours bestowed on me with an easy conscience.

In my pursuit of maturity throughout the years I have had many happy days. In my continued pursuit of maturity in the future, which I can never reach, I fully expect that I shall have more happy days. But I believe that in retrospect this day will be outstandingly the happiest of all. [Applause.]

GRADUATE MEMBERSHIP EXAMINATION, 1960

At the Third Examination held at the Essex Institute of Agriculture, Rycotewood College, and in Ghana on July 13th/15th, twenty-five candidates sat for all, or part, of the Examination. Of these, twelve candidates passed, one with distinction, and are eligible to apply for Graduate Membership, and a further two were referred in one subject which they may re-sit in 1960.

Successful Candidates, 1960

Pass With Distinction

Plowman, N. P., 4, Melbourne Court, Welwyn Garden City, Herts.

Pass

Achukwu, A. W., College of Aero. & Auto. Engineering, Chelsea.
Akhtar, S., College of Aero. & Auto. Engineering, Chelsea.
Brock, T. G., Lackham School of Agriculture, Wiltshire.
Cowen, R., 2, Council Houses, Penrith, Cumberland.
Friend, F. D., Lackham School of Agriculture, Wiltshire.
Gadsby, C. A. M., Lackham School of Agriculture, Wiltshire.
Grant, J. E., Lackham School of Agriculture, Wiltshire.
Gunning, P. R., " Braidwood," Acle, Norwich, Norfolk.
Kitchen, A., 20, Pembridge Square, London, W. 2.
Wallace, J. A. I., 3, Houghton Road, Carlisle, Cumberland.
Weston, G. J., 14, Thame Road, Aylesbury, Bucks.

METHODS OF INCREASING THE LOAD-CARRYING CAPACITY OF BICYCLES IN UGANDA

by W. H. Boshoff,* B.Sc. (Mech. Eng.), M.Sc. (Agric. Eng.), A.M.I.Mech.E., A.M.I.Agr.E.
and D. Innes,† B.Sc. (Agric.), M.Sc. (Agric. Eng.), A.M.I.Agr.E.

THE importance of the bicycle as a means of transport can be gauged from the figures of cycle imports to Uganda for the ten-year period 1949 to 1958, when some 639,000 were imported at a total cost of about £6½ million. The increasing use of cycles for load transportation is well appreciated, and some of the more common loads transported by carrier are illustrated in Plates Nos. 1 and 2.

PLATE 1.

It has often been suggested that it would be possible to use the bicycle more effectively for transporting heavier loads by employing methods or attachments other than the rear carriers at present in use. Of these methods the front carriers on standard or three-wheeled cycles appear to be unpopular with cycle users, who are said to hold very conservative views on the proper appearance of a cycle, and who, as a result, have resisted any alteration to the general shape of the cycle (1). Two valid objections to the tricycle may be that the increased weight may reduce the speed of travel when running empty, and the great difficulty of avoiding pot-holes with this type of vehicle.

The most promising method of increasing the loading would appear to be the use of some form of rear-attached trailer, which could be disconnected when no load is carried. A single-wheel trailer has certain attractions from the design point of view, but has been ruled out because of its lack of capacity and its possible effect on the balance and steering of the bicycle.

The two-wheeled trailer illustrated in Plates Nos. 3 and 4 is in common use in Switzerland, and has been found most successful. Its main attribute is undeniably the design of the hitch, illustrated in Plate No. 5. This

* Makerere College, Kampala, Uganda.
† Department of Agriculture, Kampala, Uganda.

PLATE 2.

allows rapid attachment and detachment of the trailer, and also enables the trailer to follow the cycle over all types of terrain without upsetting the stability of the combination. Above all, it has proved capable of transmitting the braking effort of the cycle effectively to the trailer, thus avoiding the extra cost and complication

PLATE 3.

of providing additional brakes on the trailer. In actual tests it was found possible to control the maximum load (330 lb.) of the particular trailer illustrated down a 1 in 4 incline with ease, provided the cycle and trailer were approximately in a straight line and the brakes in good condition.

Other characteristics of the trailer are that it weighs 56 lb., and has a combined rolling resistance with the cycle of about 2 lb. Various designs are available, the main differences being in size of chassis, wheel size and type of spokes.

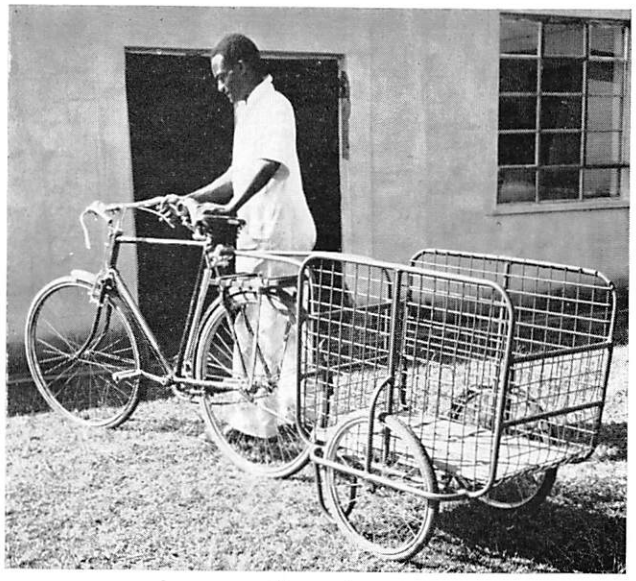

PLATE 4.

A number of tests were carried out on the trailer to assess its advantages over the carrier for conveying loads. Table I below shows the comparative weights of the common crops that can be loaded, but not necessarily conveyed, by the two systems.

TABLE I

Crop	*Maximum Carrier Load, lb.*	*Maximum Trailer Load, lb.*
Cotton	100	263
Bananas	208	330*
Sweet Potatoes ..	220	330*

* Maximum possible load on the trailer under test.

This table suggests that the trailer has a considerable advantage over the carrier, particularly where low-density produce such as cotton is conveyed. There is no doubt that this advantage could be further increased by modification in the chassis dimensions to suit a particular

PLATE 5.

type of produce. However, there are limits to the weight that a cyclist can push up the steeper hills, and these may well nullify the extra load-carrying capacity of the trailer over the carrier.

In actual tests the following data were obtained :

(*a*) Rolling resistance of bicycle and empty trailer on murram road approximated to 2 lb., and this is assumed to be independent of slope.

(*b*) Maximum sustained effort that could be applied to the bicycle by a man pushing this combination was 55 lb. ; *i.e.*, a work output of 6,000 ft./lb. per minute (2) at a speed of $1\frac{1}{4}$ m.p.h.

(*c*) Combined weight of bicycle and trailer was 102 lb.

Using the following relationship, the graph (pay load against slope) in Fig. 1 was obtained.

$$\text{Payload} = \frac{E_{max} - R}{\text{Sin } \theta} - W$$

where

E_{max} = Maximum possible effort when pushing a load = 55 lb.

R = Rolling resistance = 2 lb.

θ = Angle of the road with the horizontal.

W = Weight of the bicycle and trailer = 102 lb.

The data contained in Table I—that is, the maximum payloads of various produce that can be loaded on the trailer and carrier respectively—are also shown in Fig. 1.

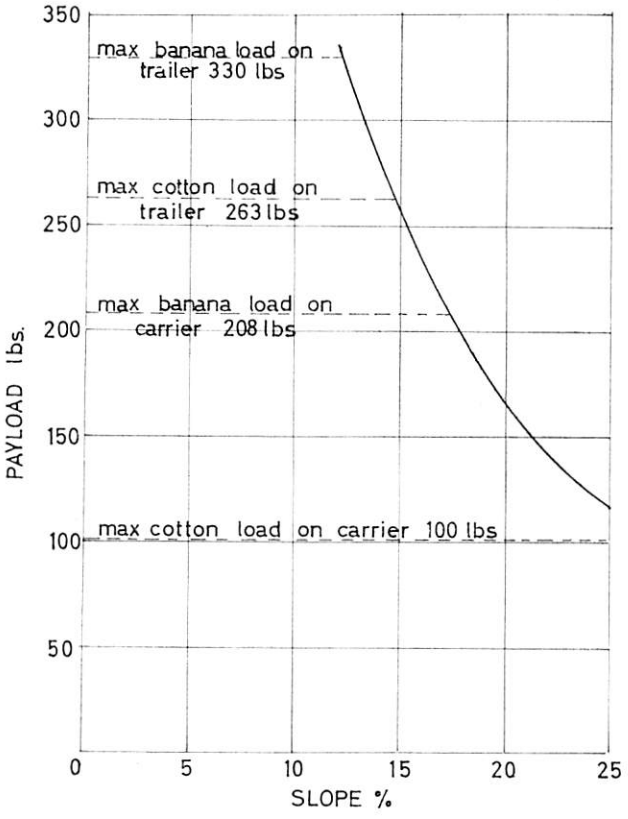

Fig I. Pushing load up slope.

It will be noted that for sweet potatoes and bananas the opportunity for carrying bigger loads on the trailer than on the carrier will only arise if road slopes no greater than 18% are encountered *en route*. In the case of cotton, it will be possible to load more on the trailer than on the carrier, and push the load up all slopes below the normal maximum for motor roads in Uganda—namely, 25%.

The cost of a cycle trailer as described is estimated at between 250/- and 300/-. Assuming a life of five years for the trailer, and further that 100 loads are carried per annum, it is estimated that the trailer should be capable of carrying at least 70 lb. more load per journey to justify the initial layout. From Fig. 1 this will be possible only if slopes no greater than 19% are encountered for low-density crops such as cotton, and slopes no greater than 14½% are encountered for high-density crops such as sweet potatoes.

It will be appreciated that for the transportation of items such as milk churns and bottles, which are difficult to pack on a carrier, or where time of loading and unloading is critical, the trailer may have special advantages over the carrier, irrespective of the nature of the terrain.

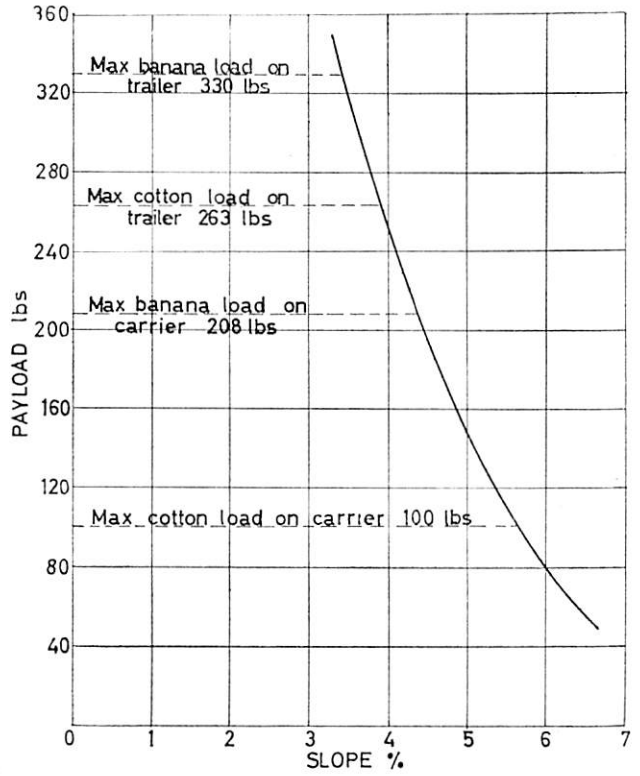

Fig. II. Cyclinq with load up slope.

Of interest, too, is the relationship that exists between slope and the maximum payload that could be conveyed up the slope whilst cycling. In tests it was found that for a standard cycle having a 68·4 in. " gear," one could expect a cyclist weighing 150 lb. to exert a gross tractive effort of 22 lb. Fig. 2 represents the relationship between slope and the maximum payload that could be conveyed up the slope whilst cycling.

It will be noted that for relatively flat country—*i.e.*, with slopes no greater than 3½%—it will be possible to cycle at all times with the trailer fully loaded to 330 lb. The opportunity for cycling will diminish with the frequency with which road slopes of over 3½% occur, unless the load is reduced in proportion at the outset—a precaution unlikely to be taken by the average cyclist. It would appear, too, that a fairly drastic change of velocity ratio would not markedly increase the chances of cycling up steeper gradients, the maintenance of a convenient forward speed for balance being the limiting factor. The extra cost of such modifications in the form of variable gear hubs is thus unlikely to be a proposition.

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DISCUSSION (CONTRIBUTED)

MR. T. S. CLARKE (BP Ltd.) supported the author's view of the importance of the bicycle, which, because of its cheapness, was the most popular form of transport in Nigeria. There were over 2½ million of them, compared with a few thousand cars and lorries. Two types were generally used—with and without a rear carrier. The latter was popular with clerks and workers who had no need to carry loads or personal effects about ; the former was generally found in rural areas, where it replaced the baggage animal. More bicycles were used for carrying

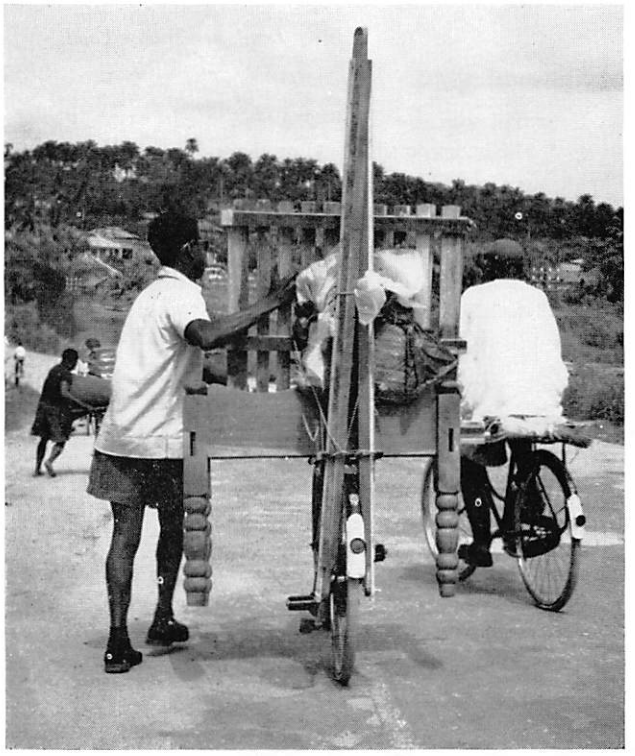


PLATE 6.

loads than for carrying passengers ; of the 2,500,000 in Nigeria, over 1,500,000 were used for carrying heavy luggage. The loads fell into several kinds and were of various weights. The commonest were bags of cocoa, palm kernels, rubber, foodstuffs, gourds of palm wine and personal effects, such as beds, chairs, tables,

cupboards and wardrobes. Bicycles were frequently used as taxis to carry two or more passengers.

In Eastern Nigeria the bicycle was a maid of all work. Frequently, foodstuffs like yams, cassava, rice, oranges and bananas were put in large pans or bowls, which were tied by ropes to the wooden platform rivetted to the rear carrier ; farmers usually went about selling foodstuffs and fruits in this way.

In the East, as well as in the West, it was usual for butchers to sell their meat from specially adapted bicycles.

In large towns, loaves of bread, cakes, scones, sausage rolls and other kinds of pastry were sold by means of bicycles. A showcase made of glass was tied to the front or rear carrier of the bicycle and the cakes or loaves of bread were put inside this glass case and taken about to be sold.

Plates 6, 7 and 8 serve to show the various ways in which bicycles are used in Eastern Nigeria.

(*Photographs : Information Division, Ministry of Information, Lagos, Nigeria.*)

PLATE 7.

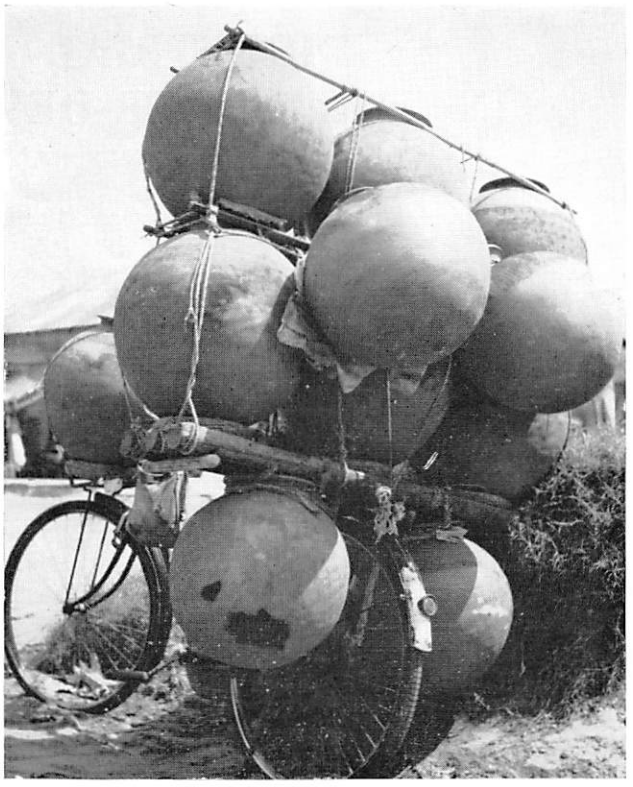


PLATE 8.

MR. P. H. BAILEY (N.I.A.E., Silsoe) wrote that while he did not disagree with the authors' main conclusions, he was critical of the application of a single value of rolling resistance under all conditions. Rolling resistance was approximately proportional to weight carried, and in fact with bicycle tyres at constant pressure would increase on a hard surface rather more than in direct proportion to the weight. Thus, with the full load of 330 lb. on the trailer, and a rider of 150 lb., the total rolling resistance of the combination at the rate of 2 lb. per 100 lb. would be of the order of 12 lb. This would considerably reduce net tractive effort when cycling, and the maximum slope negotiable would be $1\frac{3}{4}\%$, not $3\frac{1}{2}\%$. The effect of changes of rolling resistance would be less marked when the combination was being pushed on account of the greater tractive effort available, but would still tend to reduce the pay-load carried for a given slope.

The comparatively small diameter wheels of the trailer illustrated by the authors would have higher rolling resistance for unit load than normal 26-in. or 28-in. bicycle wheels, and a type of trailer with larger wheels might therefore be expected to carry rather greater loads up a given incline. The larger wheels would also give less troubles with pot holes and corrugations.

(*Extract from "Roadless News."*)

The major transport vehicles, gigantic ships, railway trains, heavy road (and even off-the-road) vehicles are all well catered for. But how many people can own or even use them ? Compared with the world population, very few. The population of the world is rapidly approaching the 3,000 million mark, and probably more than two-thirds of them must journey on their feet. Their highest aspirations, in the matter of movement, centre around a bicycle, and a push-bike at that. Many millions of Asians and Africans long for a bicycle, and to-day a small proportion of them own one. Even that small proportion may well run into quite a few millions. The bicycle as a minor means of movement has been sadly neglected and the latent potentialities still need development. A visit to many countries in the Far East will reveal that seldom will you see a bicycle carrying only the rider. The minimum appears to be two, and four or five of a family

Continued on page 78

INDUSTRIAL MECHANIZATION IN THE UNDER-DEVELOPED TERRITORIES

by W. D. RAYMOND,* O.B.E., B.Sc., Ph.D., F.R.I.C.

A Paper presented at an Open Meeting of the Institution on 12th April, 1960.

OUR overseas territories vary widely in their degree of industrialization. At the one extreme there is Hong Kong, a third of whose national production is estimated to be derived from manufacturing and which markets these industrial products in many countries throughout the world. At the other extreme there are territories such as the African Protectorates which have very little industry of any kind.

This paper will be limited mainly to a discussion of a few of the developments that have occurred in recent years in the food, including oil milling, industries in East and West Africa and in the West Indies. It may therefore be convenient to consider the economy of one of the larger West Indian islands, Barbados, which is heavily dependent on a single crop—sugar. The dominating position of sugar in the economy of Barbados is shown in the following table :—

BARBADOS—GROSS DOMESTIC PRODUCT

	Gross Domestic Product (£ million)	*Output of Sugar*		*Other Manufacturing*	
		£ million	*%*	*£ million*	*%*
1938 ..	16·5	6·0	36·4	1·3	7·9
1946 ..	40·0	15·1	37·7	3·4	8·5
1952 ..	67·0	29·9	44·6	4·4	6·6
1953 ..	70·2	31·9	45·5	4·9	7·0
1954 ..	71·0	31·7	44·6	5·3	7·5

The position of sugar is possibly stronger since the War than it was before, and there has been very little tendency for the relative position of other manufacturing industries to increase, although there may have been some absolute increase in output. Similarly, about 80% of Barbados domestic exports in 1957 were sugar. Many other islands, both in the West Indies and elsewhere, have economies based upon a single crop.

The African Territories usually differ in having a more varied crop production. For comparison it may be useful to examine briefly the relatively advanced Colony and Protectorate of Kenya.

KENYA—NET DOMESTIC PRODUCT

	Total £ million	*Output of Manufacturing £ million*	*% of total*
1947	53·0	4·5	8·5
1951	102·9	10·0	9·7
1954	126·6	16·0	12·6
1955	159·3	20·6	12·9
1956	159·4	20·9	13·1
1957 .. .. (preliminary)	169·9	23·2	13·7

* *Tropical Products Institute, Department of Scientific and Industrial Research.*

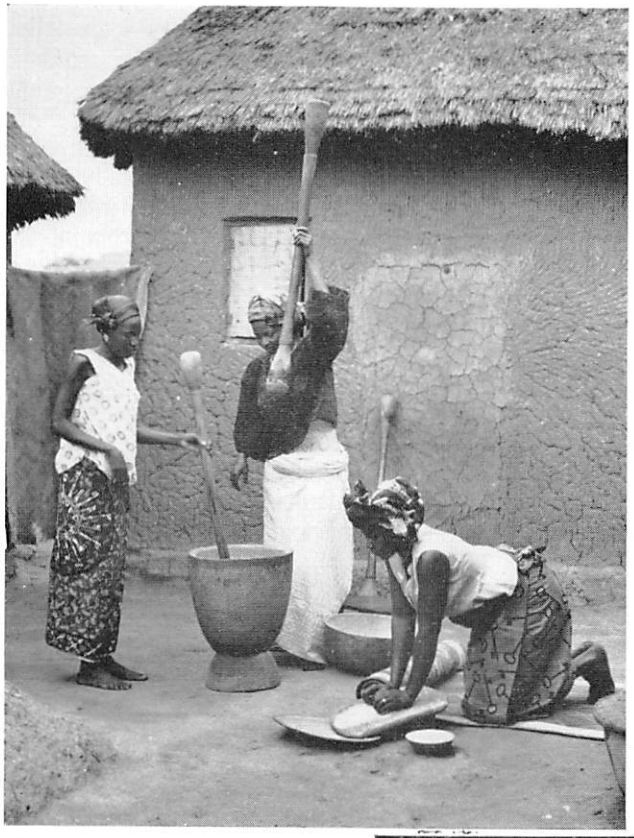
Here the manufacturing output has been expanding at a more rapid rate than the total product. The rapid change in the relatively short period 1951–6 is worth noting. In Kenya something over 75% of the industrial production is carried out in 18% of the establishments, each employing more than 50 persons. Although over 60% of the establishments employ less than 20 persons, their production accounts for under 10% of the total. In all areas the size of the readily-available market is the main factor limiting the erection of the standard type of industrial undertaking found in industrialized countries such as the United Kingdom.

In 1954 the Governor of the Leeward Islands invited me to visit Antigua in order to advise on the problem of industrialization there. Antigua, which has an area of 108 square miles, is a fertile island, having a low rainfall and a rapidly increasing population (to-day about 56,000). In 1955 its exports were 18,021 tons of sugar, 1,267,854 lb. of cotton and 728 gallons of molasses, indicating the predominate position of sugar and sea-island cotton in its economy. Its chief imports were wearing apparel, piece goods, food, especially corn meal with a consumption of about 30 tons per week, timber and non-edible oil.

Since Antigua can obtain a good yield of flint maize, primary consideration was given to the development of a maize mill. In consultation with a firm of engineers at Ipswich, trial hundred-weight lots of the local maize were milled by various unit arrangements and the products both examined in the laboratory and also sent to Antigua for consumer-acceptance trials. Following these trials a mill, dealing with ½-ton maize per hour, was erected. It is operating now to full capacity in the island. Although it has not yet been possible to grow all the maize on the island itself, appreciable quantities of the local variety have been milled and the remainder imported. Since the mill was opened it is interesting to record that there has been an increase in poultry keeping in the island. Figures for the composition of the main mill product may be compared with other meals.

COMPARATIVE ANALYSES OF MAIZE MEAL

	Present Output —Antigua (About 72% extraction)	*Highly Refined*	*Whole Ground Meal*
Moisture, %	13·4	12	12
Protein, %	10·0	8	9·5
Crude fibre, %	0·81	—	2·1
Ash, %	0·99	—	1·3
Fat, %	2·8	0·5	4·3
Thiamine, μg/g	2·3	0·5	4·5
Riboflavine, μg/g ..	0·8	0·3	1·1
Nicotinic Acid, μg/g ..	14·6 (TPI)	6 (MRC)	20 (FAO)



Nigerian Women Milling Sorghum
FIG. 1.

Maize is a staple food for many tropical territories—*e.g.*, East Africa. Large quantities are now milled there in hammer mills, but there is little doubt that with the rising standard of living in these territories the consumers will demand a more satisfactory product, approximating more in composition to the meal they were accustomed to have ground by their wives. A mill such as that erected in Antigua would give a product of good nutritional value and one acceptable to the population. Too often the wishes of the latter are disregarded.

In Nigeria sorghum or guinea corn is one of the main staple carbohydrates. It is interesting to examine briefly the process normally followed in preparing the grain for consumption. The grain is pounded in a wooden pestle and mortar, rolled by stone and the products separated on a coarsely-woven mat (Fig. 1). Guinea corn is not often milled mechanically. The meal from the whole grain is generally unacceptable, and in 1952 the Department of Commerce and Industry in Nigeria sought our advice concerning machinery. Samples of three of the common sorghums were milled experimentally in consultation with the Cereal Research Station at St. Albans and the product examined as to their content of thiamine, nicotinic acid, riboflavine and protein.

COMPARATIVE ANALYSES OF SORGHUM MEAL

	White Sorghum Meal	*Table Meal Pounded*	*Whole Sorghum*
Moisture, %	12·7	12	11
Protein, %	7·7	9·1	11
Crude fibre, %	Trace	1·3	1·7
Phosphorus total, mg/100 g.	218	—	287
phytin, mg/100 g.	34·6	—	—
Thiamine, μg/g	2·35	2·5	3·8
Riboflavine, μg/g	0·85	0·7	1·5
Nicotinic Acid, μg/g ..	31·5 (TPI)	29 (MRC)	39 (USDA)

Arrangements were then made for a pilot milling trial which was carried out by a firm in Towcester on a modified mill originally designed to deal with wheat. The mill was modified and is now operating in Nigeria.

The mill can produce about 2 tons of meal in an 8-hour day. The corn is first cleaned prior to damping.

FIG. 2.

It is then moistened by water supplied from a mechanical water wheel linked to the feed. Any interruption in the feed stops the water and hence obviates flooding. The grain then passes to the redesigned roller mill. After grinding the product is bagged.

Returning to Antigua, it was reported in 1955 that there was considerable unemployment in the relatively inaccessible south-west area of the island, associated with the decay of an arrowroot starch industry in that area. Arrowroot starch is prepared from a plant at present mainly grown commercially in St. Vincent. This was a Carib crop, and the word arrowroot is possibly derived from the Carib *araruta*, meaning mealy root ; the plant has a rhizome which after harvesting is processed for starch. The difficulties in restarting arrowroot starch manufacture in Antigua lay in the provision of adequate non-saline water supplies and in finding a market for the product. These problems were examined in the laboratory and a process developed where the starch was finally washed with rainwater. The collection and use of rainwater in Antigua goes back to the days of Nelson. The factory has now been erected, but it would be more instructive to us to examine another starch industry—sago starch in Sarawak. Sago starch is now prepared by a primitive system.

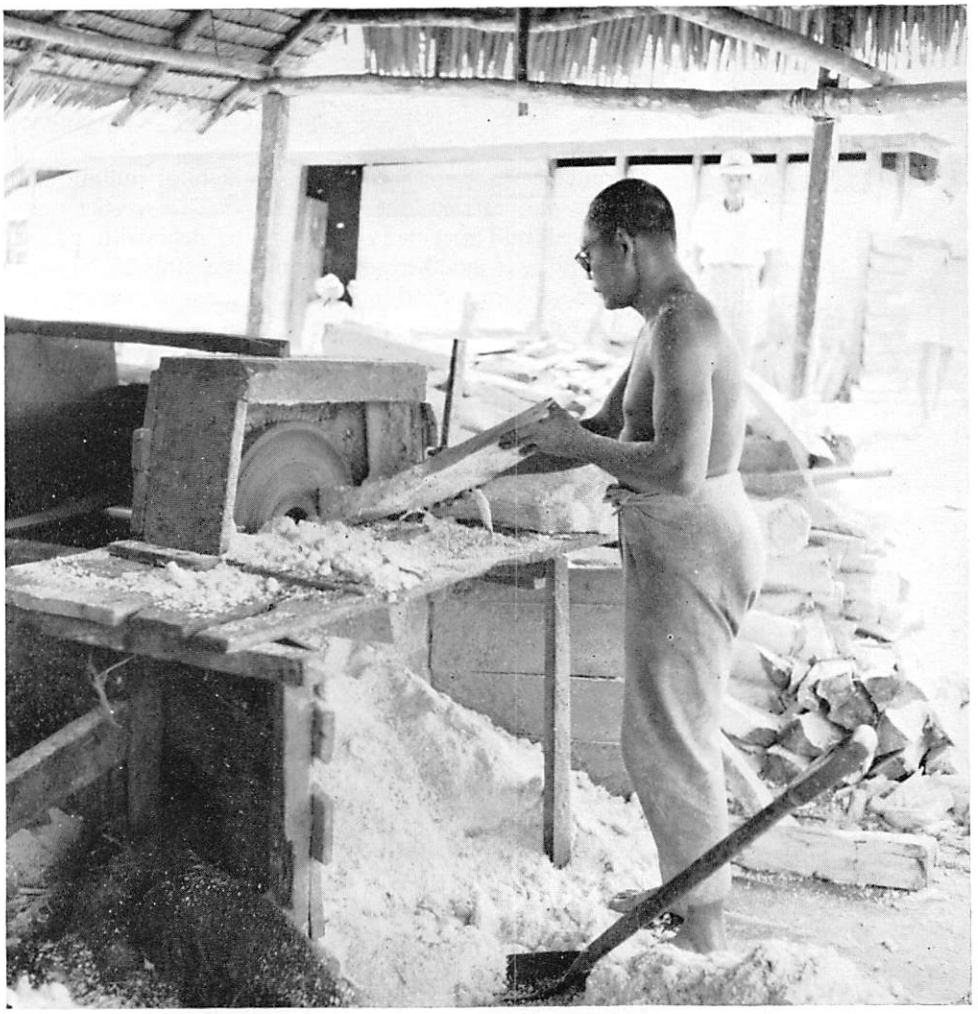


FIG. 3.

When the palm has reached maturity it is felled as close to the roots as possible and the trunk is cut up in lengths convenient for transport, generally about 3 ft. to 4 ft. In Sarawak it is the work of the women and children to roll these logs to the water, while the men fell another palm. The logs are usually lashed together into a narrow flexible raft which is towed by a small rowing boat to the village. The cortex of the trunk of the palm, which is fairly soft and woody, is about $1\frac{1}{2}$ ins. in thickness. It is removed either directly the palm has been felled or just prior to rasping (Fig. 2). When the bark is removed a block of starchy pith remains. During recent years the rasping has mainly been carried out mechanically (Fig. 3). Previously it was done mainly by the use of a long plank studded with nails, drawn backwards and forwards by two men. The simplest form of mechanical rasper consists of two circular wooden wheels studded with nails attached to a spindle. This is revolved by an oil engine and is capable of dealing with the logs from about 15 to 20 palms per day. The rasped pith, which resembles sawdust in appearance,is known in Sarawak as "repoh." This material is stored, either in roughly-made bins of sago bark or in boats, prior to the next stage of processing—*i.e.*, the liberation of the starch from the fibrous pith. This is effected by trampling the material with water on mats placed on platforms which are constructed over troughs. The water, full of unrefined starch, is caught after trickling through the mat. Sometimes a further straining-cloth stretched on wooden frames is placed on the trough. The fine material, which has been carried in suspension in the water, is then allowed to settle in the troughs. When the troughs are full, the wet flour (starch) is removed and sold to traders (Fig. 9). This wet crude sago flour, which consists of an impure starch, is known in Sarawak as "lementak." At the traders' depôt the flour is given further washings, after which it is finally dried in the sun on mats raised from the ground.

It would be fairly simple to mechanize this production by installing modern machinery, including centrifuges and vacuum drying equipment, and in consultation with the engineers of a United Kingdom firm of starch users detailed plans for a factory were prepared. The flow sheet for this factory is illustrated (Fig. 4). However, the economic trading structure in Sarawak, involving as

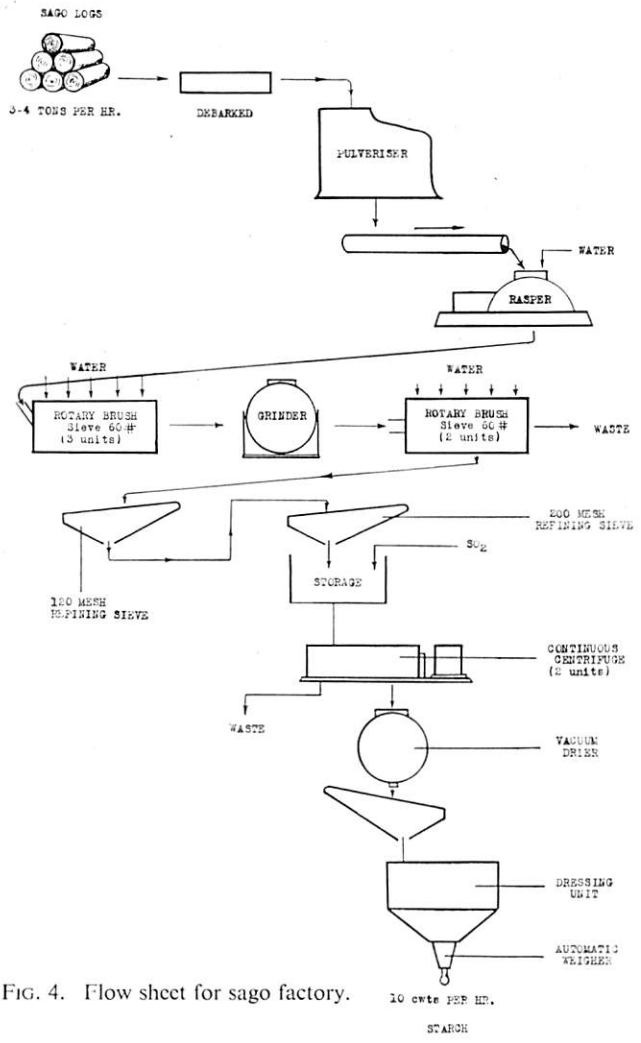


FIG. 4. Flow sheet for sago factory.

it does the sale of the sago in the palms long before it is collected, has proved an insurmountable object to any rational development. Unfortunately, in many parts of the world desirable technological improvements are prevented, not only by lack of capital and " know-how," but by other factors as well.

There is a need for modernization of starch production in several underdeveloped areas, but so far the progress made there has been disappointing. In St. Vincent, where there are still some 35 fairly primitive arrowroot factories, a modern factory of German design has been recently erected to process 700 tons of starch per season. Plans are in hand for installing additional machinery in St. Vincent, but progress is slow. Mention has been made of sago starch ; cassava starch is also produced in quantity in the Far East, but the methods employed in processing this starch are often primitive.

Returning to Antigua again, a small expeller oil mill now functions satisfactorily in crushing the cotton-seed which arises as a by-product from the sea-island cotton. It provides a local cooking oil which is appreciated by the population, as well as a seed cake for utilization, to some extent, locally as an animal feed and for export overseas. There are plans for increasing the production of oil and supplementing the small supply of cotton-seed available by crushing copra.

The problem of crushing oil-seeds to provide oil for local use occurs in many tropical territories. Most of the oil-milling factories there to-day are represented by one or two small expellers, frequently of United Kingdom origin. Milling oil-seeds in the area where they are grown has the advantage that the seed can frequently be crushed in a fresh state and hence the crude oil may be suitable for use as an edible oil without any complicated system of refining. In Kano, Nigeria, freshly-harvested groundnuts are crushed and the first pressings after filtration provide an acceptable salad oil with a free fatty-acid content, usually less than 1%. One operating firm crushes sufficient groundnuts at the commencement of the season to provide for the demand over the whole year. In small installations there is the difficulty of maintaining the machinery in an efficient state. In some areas such as India more primitive machines such as the *ghani* can operate economically in competition with the expeller. The wooden edition of the *ghani* can be operated by a single camel or bullock. Some figures comparing the efficiency of the mechanical *ghani* (Fig. 5) with an expeller, both operated commercially, show this.

	Screw Expeller		*Mortar Crusher* (Power-driven *ghani*)	
	Oil %	*Moisture* %	*Oil* %	*Moisture* %
	18·0	—	10·7	12·0
	14·0	—	9·9	11·8
	12·4	11·4	7·9	12·3
Mean	14·8	11·4	9·5	12·0

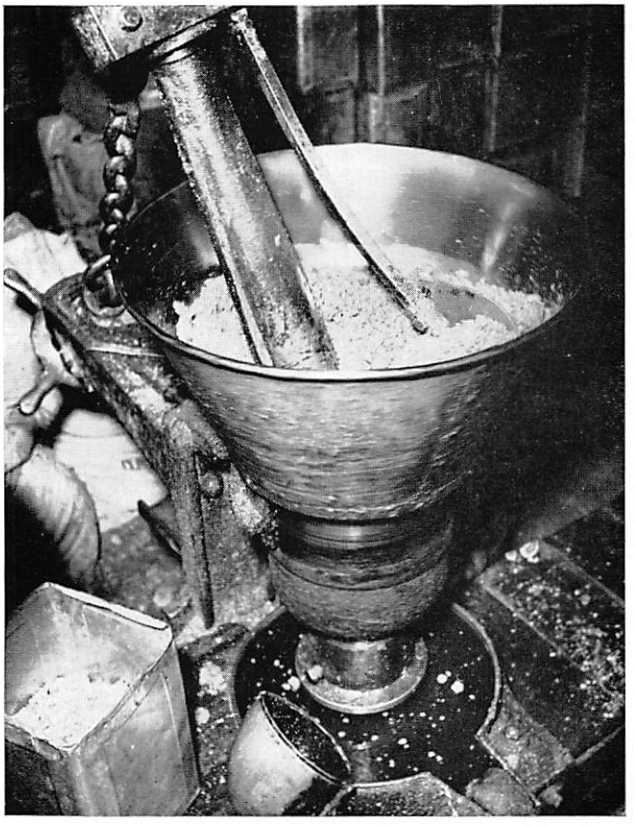


FIG. 5.

Another difficulty which exists in operating an oil mill in an undeveloped area is the virtual absence of demand for animal feeding-stuffs ; it does not pay to feed poor stock with concentrates. In West Africa there has been an attempt to utilize the residue by feeding it to humans. The diet of the local West African population is undoubtedly lacking in protein, and this deficiency could be remedied to some extent by feeding oil-seed residues. However, special care is required not only in selecting specially good quality raw materials, but in their processing. Special processing methods generally have to be devised. This has been done at Kano, and the product is now used as the basis for a concentrate which is marketed locally for consumption by infants and young children.

Before finally leaving Antigua it may be mentioned that one of the main difficulties in the industrialization of a small island is to provide continuous expert advice. In 1954 little, if any, scientific advice was available in Antigua. However, a chemist was appointed in 1956, and with his appointment progress has been possible not only in the directions recommended, but in other ways as well. Thus, the rum from the local distillery has been considerably improved. Small quantities of soap have been manufactured ; some 75 lb. aloes have been produced from the succulent which grows so easily on the island, and it is hoped to bulk this with further production next year for a trial marketing overseas. Other projects which are under active consideration are the production of essential oil, dry cleaning and confectionery.

Turning to the processing of palm fruit in West Africa, fat-splitting enzymes play an important rôle. The acid value of palm oil processed from unsterilized fruit may be 90 and over, whereas similar fruit sterilized before processing yields an oil with an acid value of 5 or less. A large proportion of our palm-oil imports, about 170,000 tons annually, come from Nigeria and about 90% of these imports are processed by Africans, often with the simplest of equipment.

In 1950 only 0·2% of the palm oil purchased by the marketing authorities in Nigeria contained 5% or less acid calculated as palmitic acid, whereas in 1958 over 77% of the oil was in this special grade. This spectacular improvement has been partly due to the introduction of new machinery such as pioneer oil mills, but mainly to the rapid sterilization of the fruit and improved general cleanliness at the primitive processing level. It will be of some interest to consider these processes and the improvements that have already been introduced. The problem of introducing further mechanical improvements is one worthy of study.

Palm fruit in the organized plantations is obtained from high-yielding strains of comparatively low-growing trees. These are cut out when they reach a certain height. In contrast the African collects mainly from wild, frequently overgrown palms, and in harvesting the bunches the fruit is frequently badly bruised. These bunches then remain often for long periods at the roadside. This allows the enzymes to act before processing. The simplest form of processing consists of damping the bunches to facilitate stalk retting and the removal of individual fruit. These fruit are then sterilized in a drum of boiling water. The cooked fruit after removal is pounded or more simply trampled underfoot. The oil is collected partly by squeezing by hand, partly by displacing it with boiling water. A more advanced procedure employs a hand press.

The importance of improving the processing of palm fruit at the village level was realized as early as the 1930's by Unilevers; and the United Africa Company, after a study of the problem, developed a small processing factory capable of handling about 12 cwt. of fruit per hour. The fruit is stripped, sterilized and then stirred in a steam-jacketed kettle, after which it is passed to a basket centrifuge. This removes the oil which after heating and settling is loaded into drums. The kernels which arise as a by-product can be dealt with by decortication followed by gravity separation—floating off of the shell in a clay bath. Although it is claimed that African hand methods only recover 55% of the oil in the fruit, as compared with 65% by hand presses and 85% by pioneer mills, from verbal reports obtained during visits to West Africa there is reason to doubt the accuracy of these figures. It would be interesting to have an independent assessment of extraction efficiency carried out in West Africa based on African-operated plants. There are now at least 100 pioneer oil mills operating in Nigeria, but it is understood that most of these cannot operate as cheaply as the more primitive African methods.

Although there are large numbers of screw presses operated, trampling and pounding methods still survive. They are operated side by side with the screw presses and the pioneer oil mills. The oil which results is transported usually by bicycle in 4-gallon tins to the merchants. Here it is bulked, tested, heated and packed in 44-gallon drums for transport, usually by road or water, to the bulk oil plant. Here the oil is washed and dried before being loaded into oil tankers. It is rather difficult to estimate how much oil is prepared by the various methods. The following figures are, however, of interest :—

AFRICAN PRODUCTION OF PALM OIL IN NIGERIA ILLUSTRATING PROGRESS OF MECHANIZATION

	1950 %	1960 %
Primitive	92·2	25–30
Hand Presses ..	6·7	65*
Pioneer Mills ..	1·1 (UAC)	5–10

* From information published by U.S.D.A., 1959.

They illustrate the progress made in mechanization during the past decade.

The oil at the most primitive level can be excellent, although, as might be expected, the quality varies widely. That from the pioneer oil mill seems generally rather worse than that from the better peasant operators.

More recent studies at the Tropical Products Institute have indicated that in addition to acidity, oxidation of palm oil is also a factor affecting quality. This oxidation can be chemical, due to the action of air in the presence of a metal catalyst ; or it may be enzymic, due to the

presence of lipoxidases in the fruit. The important practical consideration is that sterilization of the bunches should be carried out as soon as possible, preferably prior to stripping the fruit.

A large proportion of the special-grade palm oil is used to-day in the margarine and cooking-fat industries. Prior to its application in these industries it has to be bleached. It has been shown that oxidized oil is more difficult to bleach than oil carefully prepared. It will thus be appreciated that the processing of fruit is not entirely a mechanical problem. The many aspects involved in the treatment of palm fruit cannot be fully discussed in the time available, but some of the problems have been indicated.

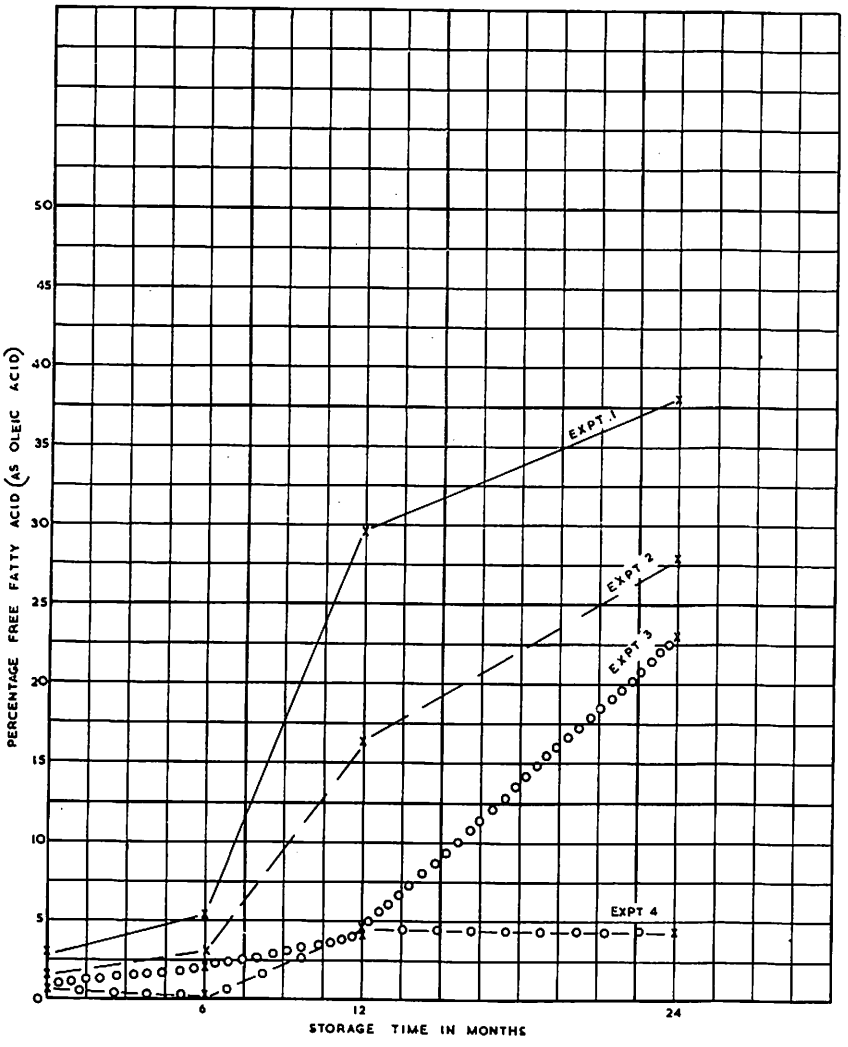


FIG. 6. Free fatty acid content of oil from groundnuts stored at Port Harcourt.

Palm kernels can be decorticated mechanically fairly easily, and machines exist for this process. However, the large majority of the 500,000 tons exported annually from West Africa are decorticated by hand. This is a fact which deserves study and full evaluation before we can speak with any assurance about mechanization in the under-developed territories.

In conclusion, it might be interesting to refer to the improvement which has been achieved in the quality of groundnuts marketed from Nigeria over the past few years. In 1956 the exports of groundnuts from Nigeria amounted to almost 450,000 tons, and whereas the 1951–2 crop had an acidity average of 5·63% free fatty acids, calculated as oleic acid, the 1957–8 crop had an average of 2·92%. One of the main factors causing an increase in the acidity of groundnuts relates to the method of decortication. In 1951–2 the main method of decortication was by pounding the pods in the household mortar. The introduction of a comparatively simple machine reduced considerably the breakage during decortication. In 1951 roughly only one-third of the nuts were whole, to-day practically the whole of the crop contains at least 70% of whole nuts. The effects of storage on the acidity of nuts stored at Port Harcourt can be illustrated graphically (Fig. 6).

Any European who visits the tropical areas of Africa must be appalled at the waste of labour—the time spent in doing some operation, often inefficiently, by hand which can be so much more easily and efficiently performed by machine. Many of the crops processed in these areas require the design of special machinery, and members of the Institution of Agricultural Engineers can perform a most valuable service by assisting in this task of design. The mechanical problems involved (*e.g.*, in the decortication of a cashew nut) are often complex and difficult. However, an attempt has been made to indicate in this brief survey that the main difficulties obstructing progress are not entirely mechanical.

The small island is always difficult ; we need not look far from our own shores to find examples. However, even an island so small as Antigua can benefit considerably from improvements in technology, whereas a large concentrated industry such as the processing of palm kernels and palm oil in Eastern Nigeria can present intractable problems in mechanization. Size of an undertaking, whilst important, is not the only factor. Mechanization in an under-developed area can often mean a considerable improvement in quality. It is not only cheaper and far easier to refine a groundnut oil containing 3% rather than 6% of acidity, but the product from the former is probably superior nutritionally and has a longer shelf life than the product from the more acid oil. The improvement of quality, both for local consumption and export, may be a more profitable reason for mechanization than the desire to save labour—at least in our under-developed areas where labour is not yet highly valued in terms of cash.

Evidently the successful development of industrialization in the under-developed territories requires special consideration by engineering firms and technologists. There is a need for close collaboration between the

engineer, the scientist and others if the countries concerned are to have the development they so sorely need.

ACKNOWLEDGEMENTS

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DISCUSSION

MR. C. F. BLACK (Unilever, Ltd.) : Dr. Raymond covered an extremely wide field in his talk this afternoon. (I was particularly interested in the remarks on sago, a crop I know very little about, and how he illustrated that, while this was a thing that could easily be mechanised from a technical angle, there were other obstacles —I understand they were commercial ones—in the way.)

I will confine my remarks to the palm oil and seed-crushing side of his talk, of which we in Unilever think we know a little. Listening to Dr. Raymond, it struck me that the mechanisation of palm oil milling in Nigeria differed from that of the other main exporting countries where the palm is nearly all produced on plantations and mechanisation has reached a high peak, with processing in very modern mills. But in Nigeria the 170,000 tons exported are nearly all grown in natural palmeries spread out over an area of two or three million acres, whereas, plantation-wise, the same tonnage could be grown on about 170,000 acres. With the trees scattered over such a vast area, mechanisation has been based on the pioneer oil mill work and on hand presses. Dr. Raymond asked me to comment on the percentage efficiencies of pioneer mills and hand presses ; I would think his figures are fairly accurate.

Dr. Raymond mentioned that the quality of palm oil exported from Nigeria had improved tremendously over the last few years due to mechanisation. I would differ from him. This has not been so much due to mechanisation with hand presses and pioneer mills as to the premiums paid for good-quality oil. Being commercially minded, the African farmer went for the premium. You can produce just as good palm oil by the primitive methods described as in hand presses if you take the necessary care. Mechanisation with hand presses and pioneer mills played its part, but mainly in increasing the quantity produced. Mr. Mulholland, when he talks, may give you an idea on how the palm oil industry could be more mechanised in these developing countries. It may be that the answer will be a large plantation with smallholders grouped round it, using the large plantation mill.

On the question of seed crushing, many of these developing countries are very prestige-conscious, and they want industrialisation at almost any cost. However, as Dr. Raymond mentioned, when you press your palm kernels locally one trouble is selling your cake, which is mainly used for animal feed, and for which there may be no local off-take. In many countries it has to be exported and local crushing may not be truly economic.

In spite of this, to achieve industrialisation, one or two countries have actually altered their export duties in such a way that whilst it will pay a company to crush in the country it is only at the expense of a loss of revenue to that country.

MR. G. C. HARTLEY (Rose, Downs & Thompson, Ltd.) (contributed) : My company engineers and supplies seed crushing machinery and mills to clients in England, Europe and almost all over the world, including under-developed countries. There are two points which I would like to mention, the first concerning the development of seed crushing mills.

We have found that in recent years the local demand for edible oil or fat in an under-developed country is often met more or less by a household method of stewing oil-seeds in a boiling pot and skimming off the oil and throwing away the residue, which, to us, would be considered an animal food. It might happen that, in some countries, an enterprising trader starts collecting oil-seeds and exporting them. Then he decides to install a small seed crushing mill so that he can export oil and cake. If he prospers, another trader follows his example, and when both prosper perhaps four more traders start. When there are six mills installed maybe the capacity will be sufficient, but often there are another six traders who still think that there is good profit to be made, and they order seed crushing machinery. Before anyone can say " stop," an inefficient industry of small factories has been created, using small, rather inefficient machinery, bad buildings and always short of capital. This leads to bad labour conditions and poor quality products, poor profits and with no great overall benefit to the under-developed territory.

While I strongly favour private enterprise and dislike controls in a developed country, I do want to stress the point that controls and therefore protection for new seed crushing mills in under-developed territories appear to be helpful. Under these conditions, it is possible to established relatively large factories with skilled technicians, both local and expatriate men, and these factories can operate with unskilled labour at a comparable efficiency with mills in developed territories. I mention this point regarding controls because there is such a difference in the seed crushing industry in different under-developed territories.

The second point concerns the need for collaboration between the scientist, engineer and others in development work. In a developed territory such as Britain, where we have our engineering works, we frequently receive approaches from a processing factory in a developed territory who bring a process problem to us. They are prepared to pay us for our work, and, all being well, scientist, engineer and financial management co-operate, a plant is designed, tested and handed over for production. Unfortunately, seldom does an organisation or person

from an under-developed country come along with the experience or resources to go ahead even if we take a heavy risk on the development work. We therefore tend to concentrate to some extent our research and development facilities on work for developed rather than for under-developed territories, because this is more worthwhile for us.

There are various Commonwealth or British Government organisations or corporations who do excellent work assisting mechanisation or development in under-developed territories, and I believe they have funds available for the employment of consultants and technical personnel for possible projects, and I would strongly advocate the increase of these funds so that it could be made more encouraging for engineering companies such as ourselves to divert more of their research and development facilities to special technical problems of under-developed countries. I particularly emphasise to engineering companies, because it is not always possible to find a developed processing company such as the United Africa Co., who could spare their time to come forward and do so much to help the under-developed country, as U.A.C. did with the particular case of the Pioneer Mills for Palm Fruit in Nigeria.

MR. J. S. MULHOLLAND (Colonial Development Corporation) : One point which Dr. Raymond has made and which I would like to stress was about consumer requirements ; his own organisation, the TPI, is a very useful source of information to us in knowing what happens to a crop, how it is produced, where it is produced and how it is processed and sold. Usually, in many of the least industrialised areas it is just impossible to find out what the need is, and until somebody gets down to it—and it will have to be a fairly skilled team of sample survey people—to tell what is wanted in these different countries, it will be very hard to plan their industrialisation. As Mr. Black mentioned, politics may interfere with pure economics on that score. Someone may want to have an industry when it does not pay them to have it and it may not altogether be a bad thing in the long run.

Another point raised by Dr. Raymond—that of something other than lack of knowledge preventing progress—is well illustrated by one of our problems. We were asked to consider financing a rice mill in a certain area of British Guiana. There has been in that country a lot of argument about the respective merits of small and large mills, and we sent a small mission out to look at this and examine the small and the large mills and their economics. It was fairly conclusively shown that a large mill would be the better proposition. It would be more efficient, give a better turn-out of rice, and better quality rice. The by-products which normally were lost in a small mill would be saved, but there was one snag—a vested interest of small rice millers who supply credit to the rice farmers at high rates of interest which partly recoups the cost of milling their rice and who are opposed to the setting up of large mills.

I would like to tell you of some of the things the Corporation has done, is doing, and is proposing to do in various territories. In Malaya we have the Jahore Palm Processing unit, a factory which cost a quarter-of-a-million pounds. Before you spend that sum, you have to be pretty sure you are going to get some palm fruit to process. We have a 5,000-acre estate run by the Corporation, the fruit from which will go to the factory, and from small growers it is hoped to get at least a similar quantity. The small growers are being helped with land settlement, but it is a case of getting a nucleus plantation which would ensure the factory of a large part of its turn-over. Oil palms and sugar cane are probably two of the best examples where this principle applies.

With a modern sugar cane factory one thinks in terms of a factory producing something like 50,000 tons of sugar per year. If one takes as a rough figure £100 invested per ton of annual production, there is a very considerable amount of money invested. In Swaziland, we are involved in factory and estates which will cost some £4 million. The hope is that sugar will be produced not only on the estates directly connected with this factory, but also by European and Swazi farmers. This is one of the few large industries which has recently been started in Swaziland. Another of our interests there is in paper pulp, and we have planted some 100,000 acres of forest, and with a large commercial associate are putting up a factory for processing.

DR. RAYMOND : I do not think we disagree on anything that has been said. I would like to make it clear that the difficulties of the sago industry are precisely those described by Mr. Mulholland with the rice industry. It is a question of the crop having been sold to traders long before the tree is felled.

MR. E. W. GOLDING (Electrical Research Association) : This is not so much a question, but I have just returned from a rather extensive tour of Africa and there is an aspect which was mentioned by Mr. Mulholland which I would like to mention. It is the development of electricity in many of these territories through the building of large hydro-electric schemes. As many of you know, in Uganda there is the Owen Falls scheme, and in Rhodesia the Kariba scheme, and these are all going forward with funds from national and international sources. Such developments bring with them a very definite problem, and it is this : There is a large amount of power available and then the problem in the developing country is " What shall we do with the power." It is difficult to transmit to the parts of the territory where power is needed. Therefore, the question is whether you should establish an industry near to the power station, as in Uganda with the textile factory to use the local cotton, or whether you should try to do some development work on the reduction of the cost of transmission and take the power out to the small users which Dr. Raymond mentioned.

I was concerned, in my tour, with the uses of electricity in agricultural work, and I was surprised to find how many uses there were in connection with drying. I found about a dozen crops for which drying was required —coffee, copra, sisal, etc.—and I went on to Zanzibar, and it was suggested that they could do with some drying for cloves. In Uganda they needed to dry a number of crops which had to be cleared out of the way to make ground space for the cotton. I think one thing to which we agricultural engineering people in this country should

certainly pay a good deal of attention is the design of suitable equipment for drying such crops, and it will, in time, certainly be electrically operated. How long it will take to get electricity supplies to the various areas concerned I am not sure.

Perhaps I could put a question to Dr. Raymond. Would he consider it desirable to push out into country districts and attempt to develop the small mills, or whatever it may be—the small dryers, power operated—or would it be better to try to bring the raw materials somewhat nearer to the power stations ? This is a very real problem which is going to be met in all the developing countries.

DR. RAYMOND, in reply : Mr. Golding has raised a very interesting point. Palm kernels are generally cracked by hand, even to-day, in spite of the existence of mechanical decorticators which can be village operated. In transporting nuts rather than kernels there is a larger transport charge for carrying a material, a great proportion of which is useless shell. Hence centralised mechanical decortication is often out of the question. A similar problem exists with groundnuts. Centralised decortication was tried in Nigeria, and although the groundnut growing area is a comparatively small one, a lot of the crop being grown within 50 miles of Kano, centralised decortication was abandoned. It was found that small hand-operated decorticators with a premium for good-quality nuts gave better results. This solution is not always applicable. Both in Senegal and in the Gambia, centralised decortication has been successfully adopted.

Therefore, it is difficult to reply with any degree of finality to Mr. Golding, but the solution of taking electricity out, not into the smallest villages, but into the small towns and then trying to group machinery around the sub-stations there is one that would deserve further study.

Drying by electricity is usually too expensive, but seemed promising for the more expensive crops. Pyrethrum is a tropical crop that might be worth examining in connection with such drying.

THE PRESIDENT : There is little I can add, except that the development of plantations resulting in the extraction of a very valuable product would seem, in itself, to throw up an important problem—bulk handling. In bulk handling, one thinks of transport and energy. The point about energy has been covered by Mr. Golding. It does seem to me that such a valuable crop must be dealt with on site and bulk handling must be taken into account. I was intrigued by a remark made by Mr. Black that the separating of these products—that is to say, the palm oil—is dealt with on site, or very nearly, whereas other seeds mentioned can be imported. I know very little about this, but I do know to this extent that, in the crushing of seed in this country, the oil industry provides a rather special range of solvents for the extraction of these oils.

One of the post-war developments which I might mention is the fact that, with ground nuts, the waste fibre is recovered and, with the aid of special solvents, forms the basis of a man-made fibre. One must recognise that there are these by-products which have another value.

DISCUSSION (CONTRIBUTED) *Continued from page 69*

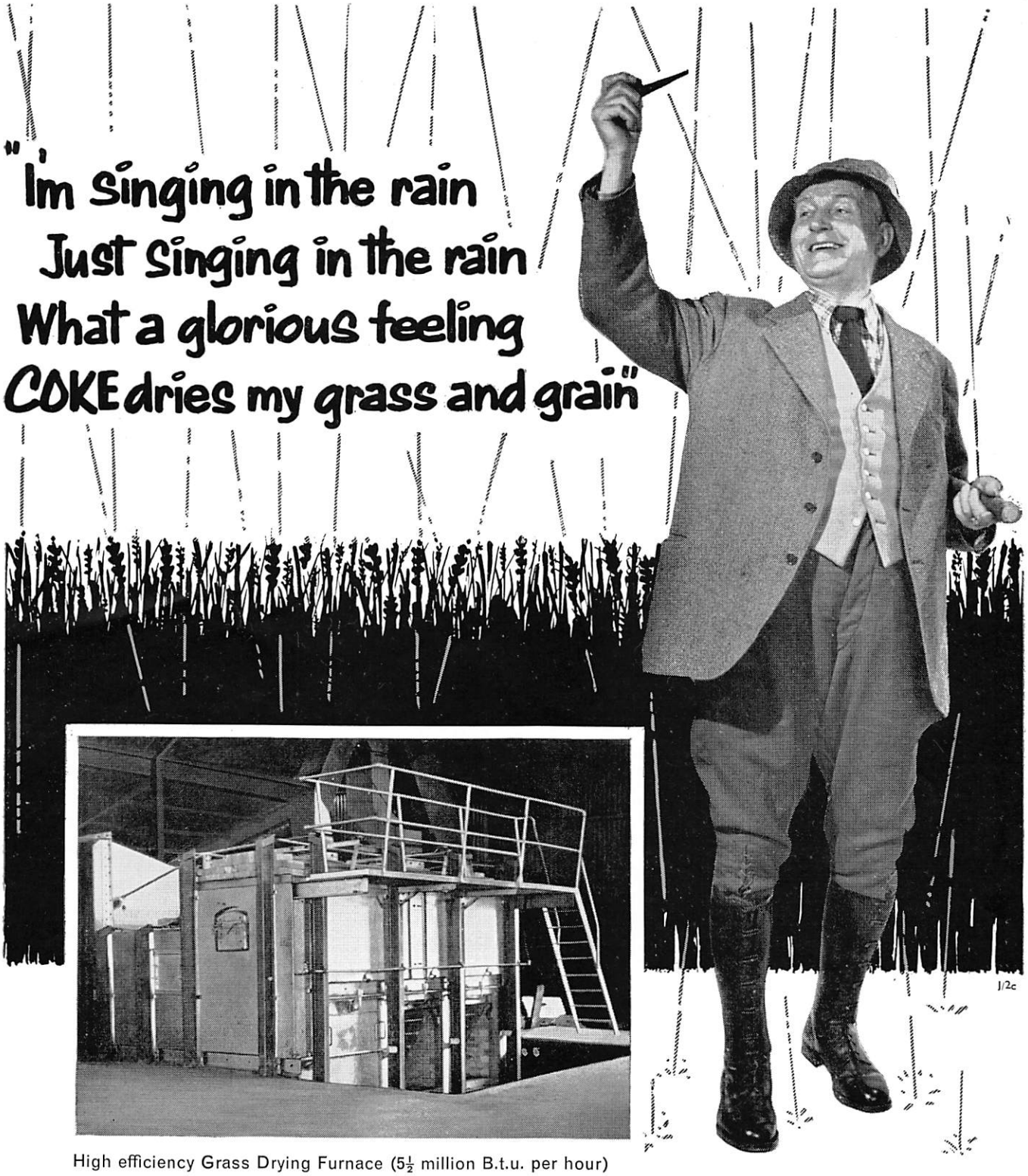
are often seen on a bicycle built for one ; modified by the owner with contraptions front, rear and centre to take the rest. A trailer would appear to meet the case. There are also many other uses to which a bicycle trailer could be put.

In the plantation rubber-growing countries of the Far East, notably perhaps Malaya, new varieties of rubber trees have been planted, which, as they reach maturity, will have a far higher yield than the trees displaced. Thus the tapper has a steadily rising load of latex to transport to the collecting stations where the latex is bulked for road transport to the factory. If some assistance is not given to the tapper, it may well arise that the daily stint of trees to tap will have to be reduced. Instead of 5 to 10 gallons of latex to be carried to the collecting station, as in the past, he may have to deal with 10 to 20 gallons. As most of the tappers in Malaya have their own bicycles, the trailer would appear to be the answer. Where the going is rough the bicycle can be pushed and ridden where there is a good path or road. The trailer carries two 10-gallon churns, and its rolling resistance is so slight that, on the level, the extra effort needed is hardly noticeable. Two churns full of latex weigh around 225 lb., but as a test pay-load 400 lb. has easily been operated.

The trailer referred to can obviously be modified in many ways to accommodate other pay-loads than latex. Somewhat similar trailers are used in Holland, and no doubt other countries, for milk. In fact, the trailer is a minor means of movement suitable to a live (human or animal), liquid or solid pay-load of any description up to, say, 250 lb. weight, and with an economic radius of action of perhaps up to ten miles.

SPECIAL GENERAL MEETING

Two slight amendments being necessary to the Memorandum and Articles of Association of the Institution, a Special General Meeting of Corporate Members will be held immediately preceding the Open Meeting to be held at 6 Queen Square on 11th October, 1960. The formal notice of the meeting will be circulated in due course.



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Twenty-six candidates were successful in obtaining the Diploma. Although eight of these attained Second Class Honours, no candidate was of the outstanding merit required for the award of the Johnson Medal, which was last presented in 1958 (for the third time since its inauguration in 1955).

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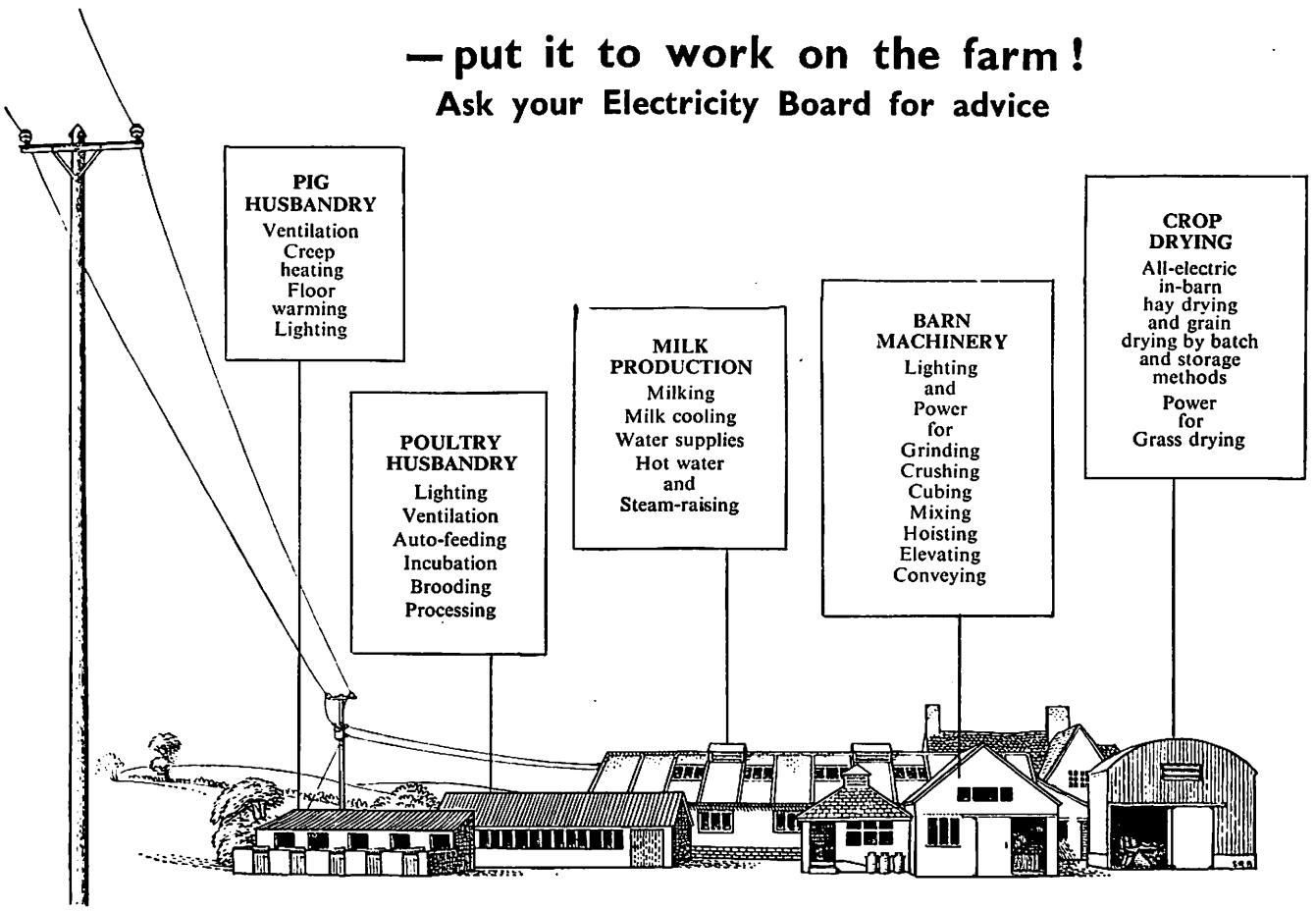

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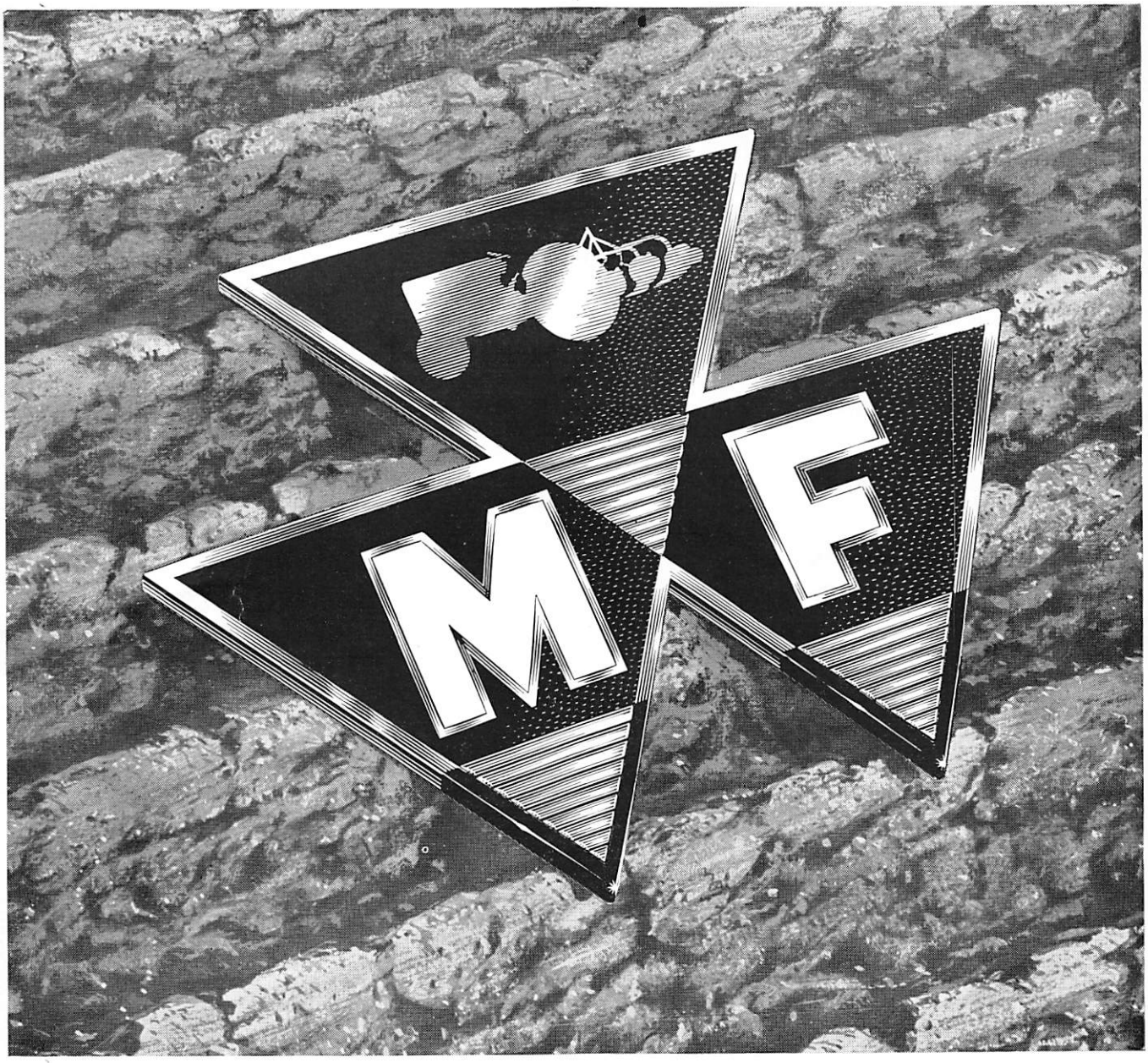

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