Sugar research is helped by annual field production surveys. The importance of surveys in all research, and particularly where the use of agricultural subsidies is involved, cannot be overstressed. It is important in the case of subsidies for example, to find out why money is well spent by some farmers and wasted by others and whether this forms a pattern.

Banana breeding is carried out in Jamaica and a limited amount of fundamental work is undertaken in cytology. There are very few other areas where similar work is being carried out. This is not so in sugar cane, which is fortunate in that much research fundamental and otherwise is being carried out by many of the sugar industries of the world. Bananas also suffer from having a process of progeny evaluation which by its very nature is extremely laborious. The Jamaican sugar industry along with other former British West Indies industries contributes to the now world famous Breeding Station in Barbados. Whilst producing our own varieties we also test the main commercial varieties produced internationally. In common with other commodities quarantine precautions have to be observed in bringing material in from outside Jamaica. In this respect sugar is fortunate in that we are being allowed by the United States Department of Agriculture to quarantine cane varieties in Washington. New germ plasm has recently become available from Burma and incorporation of this into the breeding programme should prove extremely interesting. To maintain the output of sugar requires a continuous process of producing and growing new commercial varieties.

Economic considerations are at least as important as the results of research, and each must be related to the other. In the sugar industry for example, we have technical information to show how yields of about 45 tons cane per acre can be achieved — a level of yield approaching that of Hawaii, whereas our average yield at present is nearer 35 tons per acre. But to achieve high yields commercially is not economically feasible, e.g. the average price of sugar is of great significance. Jamaica gets £25 per ton (or less) for each extra ton whilst Hawaii gets nearer £55. (The dominant agricultural requirement necessary to produce high yields is generally an adequate water supply to the plant during most of the year and in many areas this is impossible whilst elsewhere costs are limiting. To drive yields upwards by heavy fertilizer applications affects cane quality adversely so that the increase in harvesting and processing costs outweigh the increased sugar returns. In passing, many other sugar areas, Hawaii and some of our competitors included, are highly favoured by nature where cane quality is concerned. Generally, levels of commercial

yield reflect the equilibrium b

A consideration in sugar
water which is very critical
Monymusk deserves credit for
use of irrigation water. The m
some difficult engineering prob
use of irrigation water is limi

All three commodity boar
varieties need to be resistant
lethal yellows problems. Virus
Research Department acknowl
had and is receiving from o
Banana Board Research Depart
help from a virologist.

The quality of bananas ar
nomic significance and the qu
empirical work has been done
tinue in an empirical fashion
study of the physiology of ripe
some of the work currently p
facilities of a large phytotron a
knowledge. Other fundamental
financed by private industry i
including Trinidad.

The short-lived higher pr
something about which we woul
that we may be incurring pena
The running down of sugar yiel
nation and in this field the work
out in Hawaii is of interest. Th
sphere could well be significant
this subject.

The only entomologist emp
is at present studying cane fly
important pest.

At the present time, whils
tinue to be important, our Indus
falling prices, higher wages and
as possible, i.e. a virtual limitati
which make competitive agri
difficult.

* *Added by the author*

yield reflect the equilibrium between all the factors involved.)*

A consideration in sugar cultivation is the optimum use of water which is very critical for plant productivity. In Jamaica Monymusk deserves credit for the work which it has done on the use of irrigation water. The more extensive use of irrigation poses some difficult engineering problems and in some areas the further use of irrigation water is limited by shortage of supply.

All three commodity boards face virus problems. Sugarcane varieties need to be resistant to mosaic and coconuts have their lethal yellows problems. Virus also attacks bananas. The Coconut Research Department acknowledges particularly the help it has had and is receiving from outside in this respect, whilst the Banana Board Research Department feels that they would welcome help from a virologist.

The quality of bananas and coconuts is of considerable economic significance and the quality of sugarcane is also. Much empirical work has been done on chemical "ripeners" but to continue in an empirical fashion may be of doubtful value. A basic study of the physiology of ripening is required and in this respect some of the work currently proceeding in Australia where the facilities of a large phytotron are available, is yielding useful basic knowledge. Other fundamental research on sugarcane is being financed by private industry in several other sugar territories, including Trinidad.

The short-lived higher productivity of some virgin land is something about which we would like to know more, and suggests that we may be incurring penalties for indulging in monoculture. The running down of sugar yields is attracting international examination and in this field the work on cane root exudates being carried out in Hawaii is of interest. The microbial content of the rhizosphere could well be significant and Dr. Hogg is currently studying this subject.

The only entomologist employed by a commodity association is at present studying cane fly, which is probably sugar's most important pest.

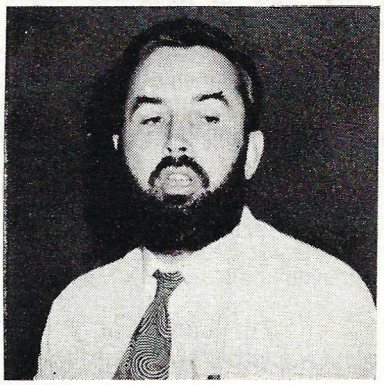
At the present time, whilst the value of research will continue to be important, our Industry in common with bananas faces falling prices, higher wages and a plea to employ as many people as possible, i.e. a virtual limitation on mechanisation — conditions which make competitive agricultural production particularly difficult.

* *Added by the author*

Mr. R. F. Innes' contention that monoculture was perhaps inherently 'sinister' as regards productivity levels was challenged by the evidence from the Ceylon tea culture where sustained monoculture had been accompanied by a doubling of yields. Dr. Lamb went on to suggest that equally worthy of attention was the increasing importance of nematode attacks. Mr. Innes later in the discussion re-iterated his view that, where the cost of extension was borne directly, its recipients were both more attentive and more critical.

A Strategy for Agricultural Research in Jamaica

Dr. D. T. Edwards, Department of Agricultural Economics and Farm Management, University of the West Indies, Trinidad.



The 180 years of scientific investigation into Jamaican agriculture has developed from the assessment of plant introductions to more complex matters, but up to the 1940's the volume of work was small. Substantial research began in the 1950's when the Department of Agriculture was strengthened and the Sugar Industry began its own field research. Other commodity organisations eventually began research programmes (Banana Board 1956, Coconut Industry Board, 1959). Work in Jamaica has been supplemented by work in Barbados (sugar breeding and Trinidad (general agricultural research).

The over-emphasis on sugar research, compared with that devoted to other export crops, has been reduced but research into the problems of small farming and local foodcrop production is far from adequate. This is only partly due to the limited research resources available. Since the Island is so varied (in regard to climate, soils and altitude for example), the subject is a complex research problem. A large range of products are grown by farmers of varied ability, using widely different techniques.

Large estates tend to follow recommended practices but this is less common on small farms where such techniques may, in any case, be uneconomic — for the appropriate intensity of resource use varies with the supply of resource.

To increase the supply of useful knowledge one could firstly make greater use of results obtained both here and elsewhere including, for instance, a considerable body of work which has been undertaken at the Imperial College of Tropical Agriculture and is being done at the School of Agriculture of the University in Trinidad.

Secondly, useful knowledge could be obtained by increasing the funds available for Jamaican research. Although proportion-

ately we may already be spending more on agricultural research than, say, the U.S.A. or Great Britain, this may be justified by the relatively little reliable knowledge available, the varied agriculture and natural conditions, and because of the irreducible minimum scale for effective research. Provided research is well chosen and is properly exploited an increasing volume should be undertaken with a view to increasing the economic output of agricultural produce.

Thirdly, useful knowledge could be increased by a discriminating choice of projects optimally combined.

The Choice of Research Lines

The choice of projects may be guided by the following considerations:

A. Efforts should at any one time be concentrated on a relatively small number of enterprises.

B. These enterprises should be chosen from amongst those that are likely to be important (and have good prospects) when the results become available.

C. The experiments should be directed at problems which are not only important but also hold promise of benefitting from the results of the experiment.

D. No attempt should be made to encompass that whole range of natural conditions under which an enterprise is conducted; rather work should be concentrated on the modal range, at least in the beginning.

E. Likely costs of experimental work as well as likely returns should be taken into account.

One should take into account the present significance of a product and its possible future importance, together with its place in current farming practice before committing research expenditure to it. Clearly more information is required concerning present farming systems.

While an underlying assumption of a great deal of agronomic

work is that much farm practice must be changed to take advantage of experimental results the present author contends that this approach may be changed. Since some present systems are remarkably difficult to change it seems wise first to identify their possibilities for change and then to design research to take advantage of these possibilities.

Where farm practice differs widely from that of experimental stations the work of the latter must be tested carefully on farms for its applicability: this involves something of a survey approach. By such procedures research is likely to receive an element of realism.

As research develops the relative importance of initial assumptions may change so that provision for revision of the programme must be made. This will influence for example the order of priority originally given to different projects.

Direct money costs cannot always be specified with certainty while the opportunity costs and returns are virtually impossible to estimate at all closely. When however the elements relevant to a problem are made explicit the most reasonable lines of action can usually be chosen fairly easily.

The Administration of Research

Relatively little attention has been given in this paper to the administrative aspects of research in Jamaica. But considerable reorganisation would be required to allow some of the recommendations implicit in these conclusions to be made effective. There is need for a co-ordinating body to help to formulate a coherent programme relating to the problems of the island. The work of the individual research workers would have to be closely directed for the sake of the programme as a whole. With this close direction it should become easier to arrange inter-disciplinary projects and to ensure that adequate consultation between the technical research officers and the statisticians and economists takes place at all stages of the work, from its inception to the translation of the results into useful terms. The special skills of the economists and statisticians could be enlisted, too, in formulating the whole programme and assisting in any research by survey, which might be undertaken.

Some means must be found of taking greater advantage of the presence of both the extension and research staff within the

same organization. The research workers need to be adequately informed by the extension staff of the farmers' problems, and the extension staff must be acquainted with the findings of research so that they may transmit them to the farmers.

Application of the Results of Research

When results become available from experiments (or trials) it is desirable that they throw as much light as possible on the problems investigated. Far from concealing the effects of natural variations by averaging the results, the research worker should expose their frequency and extent so that he may indicate the probabilities of the occurrence of variations in natural causes. Thus crop failures due to natural causes can sometimes be turned to advantage: they may be seen as adding to knowledge, rather than spoiling an experiment. It is also desirable that the results should be translated into value terms so that their practical relevance becomes more apparent. And most important of all, the extension officers should be trained to teach the farmers that the results give only general indications of the value of applying a particular practice. The individual's particular natural conditions, his peculiar managerial ability, and his other resources, and goals must all be taken into account in considering the application of the practice in question. In the last resort, the individual farmer must test a new practice under his conditions and judge its value to him in the light of his circumstances.

In advising farmers, a course needs to be steered between neglecting to transmit well-established knowledge, thus losing the opportunity of using new lines of investment and, on the other hand, putting more weight on the available knowledge than it can bear, with the result that the persons acting on the knowledge will, on occasions, suffer disappointment and so develop a lack of confidence in the advisers who innocently mislead them.

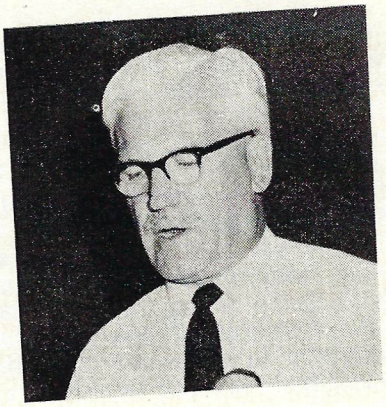
DISCUSSION

Discussion began by considering the problem of screening results. Dr. Edwards considered that an organisation should be capable of screening its own results. He in reply to a question did not necessarily commit himself to advocacy of a new research centre. He agreed that it was important for scientists to exchange ideas and to prevent overlap. It was generally agreed that the U.W.I., the M.A.L. and the commodity organisations could co-

operate to assess priorities and that such a review was necessary. Mr. R. F. Innes pointed out that we had little information regarding deployment of natural resources and went on to suggest that extension was futile unless the advised had confidence in those advising. He remarked that sugar research was centrally organised but supplementary efforts at the local level of the estate were integrated with it.

The Regional Research Council
In Relation to Jamaica's Agricultural Needs

Dr. J. Lamb — Director of R.R.C., Trinidad



The Regional Research Centre was established in 1955 to promote full-time research specialists for other research. This organisation increased and extended the type of research work done by the Imperial College of Tropical Agriculture. When the University took over the College the R.R.C. was absorbed with it and the two combined to form the School of Agriculture (on the recommendation of the Bradfield Mission which reported in 1962.)

During my career I have become accustomed to steady improvements in the efficiency and production of the industries I have served due basically to economic pressures but since my return to the West Indies I have been disappointed here by the apparent lack of progress in the greater part of the region.

Pangola grass was first introduced into Florida in 1937 and released in 1940. In the next 15 years beef production increased 450% due largely to improved pastures. In Trinidad this grass was introduced in 1953 and released in 1957 but by 1965 there was no sign of any dramatic increase in beef or milk production. Why is this?

The problems presented by the need to spray 4,000,000 acres of peasant farmed cocoa in Ghana were according to some people impossible. However because of an excellent extension service (incidentally independent of, but liasing with the West African Cocoa Research Institute) the farmers saw the **practical** results of spray application and by 1960 cocoa exports had risen in five years from 200,000 tons to 400,000 tons.

Since returning to the West Indies I have heard much criticism of agricultural research and of I.C.T.A. It is remarkable that within eight miles of this old and distinguished institution

imported Irish potatoes are cheaper than locally produced starch sources. Scientific research is not a magic wand and its results must be extended to those who are to benefit. Agricultural extension work is the responsibility of Government Departments of Agriculture. Obviously this is easier for large plantations than for small holdings but even for these the task is capable of solution.

Extension advice has to be practical if it is to succeed and I believe that there is grossly insufficient applied and operational research on which to base such advice going on in the region. While basic research is vital, our progress in the immediate future must depend largely on the application of existing knowledge.

The R.R.C. Programme

1. **Soils:** Jamaica has now been almost completely soil-mapped and is moreover the chief beneficiary of this part of our work. This includes usually land capability observations of the main soil types. The full value of this work unfortunately will not be obtained until soil fertility studies are undertaken. We do however need funds.

2. **Food Crops:** Progress with selection and breeding of food crops is very satisfactory. Sweet potatoes yielding 6 tons/acre are available and 0.49 is being propagated here as is a Lisbon type yam giving 10 tons/acre notwithstanding severe **colletotrichum** attacks. A dwarf pigeon pea yielding 8,000 lb. of green unshelled peas/acre and ripening uniformly is available. Tomatoes too have been significantly improved.

Given adequate facilities we plan to transfer two members of the food crop breeding team to Jamaica in the near future.

3. **Herbicides:** Much progress on herbicides has been made but the greatest care is required using a new herbicide on a familiar crop. I promised Mr. Kasasian, our Herbicide Agronomist, that I would strongly emphasise the need to study most carefully all recommendations made in our publications. He is to be transferred to Jamaica at the end of 1965.

4. **Plant Protection:** This section has suffered greatly from staff shortages. No advisory visits have been refused but this has been at the expense of research. I am most unhappy about our lack of knowledge regarding the practical application of modern fungi-

cides and insecticides to food crops. Moreover we have no provision for either a virologist or a nematologist. My experience in cocoa breeding makes me unhappy about the prospect of breeding without a virologist. Nematodes are an acute problem in the Windward Islands and we cannot help as we would wish.

5. **Cocoa:** Great help has been forthcoming from the Cocoa Alliance and practically all the high yielding cocoa here originated in Trinidad. Except for black pod problems all Jamaica's research needs for this crop are covered.

Finance

To the R.R.C. the chief contributors are Jamaica and Trinidad £23,000 each, U.K. £124,000 and the Cocoa Alliance £20,000. Beside the £600,000 p.a. for cocoa in W. Africa and £200,000 p.a. for tea research in Ceylon provision for R.R.C. is meagre. Although the West Indies are collectively small their needs are greater than these other areas. So far neither crop production, animal production nor economics has been mentioned. Here the R.R.C. is complemented by the resources of the Faculty of Agriculture.

Professor Tai, head of crop production is well known here. The work of his departments is greatly helped by a demonstration plot of 60 acres financed by Texaco. Here field testing of new crop varieties is conducted on a field scale — a necessary adjunct of research.

Agricultural engineering work has developed machinery for lifting food crops but the difficulties with yam may be resolved by breeding smaller ones for which there is a market preference. Development of mechanisation studies though vital has been hindered at each stage by lack of funds. One further point here — we are interested in a joint project with Massey Ferguson on the economics of **complete** mechanisation for production from small sugar estates.

Our greatest present difficulty is research in livestock production but we now have the distinguished services of Professor Mahadevan available. Unfortunately his facilities are very limited and funds must be found. Analysis of the Bodles records has been begun and the services of Professor Mahadevan are readily available to Jamaica.

Dr. Edwards heads the Department of Agricultural Economics and proposes when facilities and funds permit to extend his studies

of land settlement schemes and the possibility of replacing imported with homegrown food crops.

In agricultural research co-operation is the only feasible prospect for the West Indies and close links must be built up among us.

I believe that an agricultural research institute in Jamaica run by a statutory governing body nominated by the Ministry of Agriculture, the Agricultural Industry and the University could best provide the necessary facilities. Within this organisation staff of R.R.C. could work. International aid is easier to obtain when insularity diminishes. Furthermore I believe an annual conference of technical officers, and agricultural administrators held in the various islands would stimulate research and development. While land grant colleges may be feasible for Trinidad and Jamaica for the other islands they remain a dream.

(Discussion of the last paper was included in the general discussion immediately following and was introduced by Senator R. Burke).

General Discussion

Senator Burke suggested that from the farmers point of view the U.W.I. could be regarded as a 'land grant college' and as a recipient of the farmers problems. He indicated too that intellectuals should keep their feet on the ground.

Reference was made to basic banana research conducted at I.C.T.A. (Trinidad) and now transferred to Bodles and how useful it had been. He urged that (so far as scientific caution would allow) when answers to problems became available they should be applied forthwith.

He offered the moral support of the J.A.S. to all research units in Jamaica but commented that R.R.C. literature did not in fact appear to have adequate publicity.

Senator Burke concluded by commenting on the expensiveness of terracing to increase productivity of hillside land and by remarking about the value of Trinidad agriculture students working for a time under the conditions of Jamaican small farms. He then threw the meeting open to general discussion.

(The discussion which followed was lively and prolonged and of course moved in many directions. However several themes emerged and the main points are summarised below.)

1. Small farming.

A proposal put forward by the J.A.S. was that since the majority of Jamaican farmers worked on small units often on poor soil research must be organised to take proper account of their problems. Extension is often unsuccessful on these farms presumably because the aims of the extension officer and the farmer do not always coincide. It was suggested therefore that a scheme involving the University and the M.A.L. should be set up giving research workers full access to all aspects of the work of the farm and so that the farmer would be a participant rather than a more passive observer as on an open day extension demonstration. It was felt that in this way the results would be more clearly evident to the farmer.

The proposal was criticised chiefly on the grounds that this required the farmer to do even less to further the work of hillside agriculture. If one takes entire charge the farmer does not feel involved.

A second proposal mentioned briefly was that some kind of research was necessary to determine an orderly pattern of credit availability for the small farmer.

Throughout the discussion there was an implicit comparison of large scale and small scale farming practice and to which expression was frequently given. It was mentioned for example that a large property representing the livelihoods of many people was perhaps unfairly represented in the census as belonging to one owner.

It was also objected that comparisons should be preceded by an attempt to establish a valid basis of comparison.

An interesting point raised was in regard to what constitutes an economic unit. Redistribution it was felt, should be made on a basis of the skill and resources of the farmer. An instance was quoted of 17 tobacco farmers working 300 acres and employing about 600 other people. Their relative prosperity compared unfavourably with farmers in Christiana and Trelawny farming perhaps 40-50 acres each.

2. The Significance of R.R.C.

It was suggested that information from the R.R.C. soil survey of Jamaica should in fact have been more comprehensive but in reply it was pointed out that the R.R.C. had wished to do more and done in fact what funds would allow. Dr. Lamb said that in regard to pigeon peas data for the costing of commercial production was available and that the newer strains were dwarf and had uniform ripening, thereby simplifying harvesting. Mr. Stuart outlined the regional terms of reference for R.R.C. and pointed out that problems like pimento and ackee could not be sent there. It was countered that Grenada had benefitted from nutmeg studies of R.R.C. even though this was scarcely a regional crop.

In the course of his remarks the British High Commissioner representative commented on the financing of R.R.C.

Dr. Lamb re-iterated his belief that the Faculty of Agriculture should concern itself with up to date extension methods as recommended by the Bradfield Mission.

3. The Disposition of Research

Mr. Stuart raised the question of how background research was to be accomplished. Regional matters are referred to Trinidad; applied matters are for the most part the concern of Hope. Basic matters of concern only to Jamaica had at present no obvious destination. He again referred to the good relations existing between the Botany Department and M.A.L. and pointed out that this rested upon fortunate circumstances rather than deliberate planning. He stressed the need for some kind of background research institution. Mr. Morrison of Y.V.L.A. proposed a national institution for agricultural research as far as possible independent of politics and operating through dependent sub-committees responsible for various crops. Mr. Willcocks cautioned against a multiplicity of bodies and proposed a National Research and Development Foundation. He felt that the Government should be represented but not necessarily with greatest prominence. Such a body should involve professional agriculturalists and other specialists too, so as not to be concerned with just agriculture. He commented on the importance of technical knowledge needed for processing crops.

4. The Financing of Research

Although not specifically discussed at length this of course

intruded into the meeting at various points. Dr. Chapman remarked that while the U.W.I. Botany Department was ready and able to help it was prevented from doing so by lack of funds. The organisation Mr. Morrison proposed could he thought be financed from the Government, commodity associations, mercantile organisations and that it should incidentally be apolitical and preferably located on the University campus.

Overseas aid is a significant factor in Caribbean research at present and the British High Commission representative Mr. Wolverton read a prepared statement summarising the United Kingdom contribution here. He referred to the technical assistance programme of that country and the establishment in 1959 of the Overseas Research Council. Apart from C.D. and W. Funds some £6,000,000 has been allocated for 1963/66. Grants made to Governments and Universities are, he said, usually 50% of the total cost although rather more is paid toward R.R.C. Mr. Wolverton pointed out that ⅓ of the funds allocated are spent in the U.K. in the centralised part of the programme. He reminded the meeting of the work of the Tropical Products Institute, the Agricultural Research Council and that sponsored in British Universities. M.O.D. funds are being used for research in natural resources and have contributed in Jamaica to banana breeding and coconut germ plasm collection. He concluded by emphasising that Britain was prepared to sponsor work on behalf of developing countries and saying that Dr. Horner, the assistant research director of the Ministry of Overseas Development would arrive for discussions on June 29.

5. Future Planning

The general concensus of the meeting was that after the subject of agricultural research in Jamaica had been extensively discussed a steering committee should be appointed to consider the next step.

After due consideration it was decided to set up a steering committee of three representing the principal research organisations other than the commodity boards — namely the S.R.C., the M.A.L. and the U.W.I., the committee having power to co-opt. (Senator Burke representing the J.A.S. and a co-sponsor of the Seminar was in fact co-opted).

Some Conclusions

It was evident that those present at the Seminar appreciated the urgency of the situation facing Jamaican agriculture having

to work against an increasingly competitive world market abroad and an expanding population at home. There was too an awareness of the relative inflexibility and inefficiency of small scale farming in relation to national needs. Moreover the problems facing extension workers as an adjunct to the research process were fully discussed.

Research is divisible into several categories and the meeting accepted with few reservations that the University had a responsibility for work of a basic nature. In this connection the move to place R.R.C. staff in Jamaica was approved with enthusiasm. The Botany department's willingness to accept basic problems of a non-regional character also met with approval.

It seemed evident too that the importance of agricultural research should become an object of wider concern. (One way of doing this would be to publicise figures for Jamaica showing a comparison between the annual rate of population increase and the annual rate of increase of agricultural production as is already done on a world scale.)

Occasions like this tend to raise questions rather than to solve them and perhaps little more could be expected in the way of settled conclusions. There was however, at this meeting, a sober awareness that without an increase of research effort in the face of the most daunting problems, the tantalising ecological possibilities of Jamaica must with ever increasing rapidity pass irrevocably beyond our grasp.