TROPICAL AGRICULTURAL RESEARCH.*

A PLEA FOR MODERN INDUSTRIAL METHODS.

TROPICAL agriculture differs from agriculture as it is practised in temperate climates in general and in England in particular in so many respects that the farmer brought up to the latter conditions is compelled to adjust himself to a new orientation when he turns to the former. This difference lies not merely in the practice of agriculture through differences of crop and through differences in the response of the soil to treatment under the very different conditions of temperature and rainfall; it lies equally in the economics of management and production. Diverse as the tropical land systems are, they have nowhere assumed that intricacy which is characteristic of such countries as England and is the product of centuries of legal precedent. Both the practice and economics of tropical agriculture are, relatively, in a state of flux and capable of being moulded in directions favourable to production. In this lies its opportunity for it may be moulded in a manner English agriculture cannot owing to the rigidity which age has imparted to the system, to take full advantage of the newer teachings of science and economics which are of recent growth and the outcome of research.

ORGANISATION OF RESEARCH.

The importance of research in its application to agriculture in general, including tropical agriculture, has not lacked recognition. The output is, in fact, so great that difficulty is experienced in keeping in touch with it in all its latest developments. But it may be questioned whether use of this output is being made to the full. The reasons are various; on the one hand, the development of the tropics has been largely the work of business men and financiers to whom the more kindly conditions have readily yielded a rich harvest. Profits to those early in the field have been generous, as they were to the early industrialists, and the need for the refinements which follow the application of technical knowledge was not patent. But there is the same tightening up in process, both in tropical agriculture and in industry. The exhaustion of virgin soils combined with increasing competition is gradually demanding greater technical skill on the part of the producer, and a change is in process which is only brought about by economic pressure. On the other hand, control of research has tended to concentrate in the hands of bodies which have not the direct personal incentive of the producer as their driving force. Chief of these bodies are endowed institutes, government departments and research associations. Even in the latter, in which the personal interest is more direct than in other forms, there is not that intimate association with practice which exists in the research department of a business unit. Both conditions tend towards a divorce between practice and research, to the detriment of both: and this tendency is emphasised by the very human desire, on the part of the producer, to leave alone a subject of which he understands little, and, on the part of the research worker, to follow up those lines of work which interest him most, lines which, in the majority of cases, lead him to the more general aspect of a problem, and away from the more special aspect. In both cases it is the conditions, rather than the

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individual, which are at fault, and it is in the conditions that a remedy must be sought if research and practice are to pull their full weight in harness together.

THE INDUSTRIAL ANALOGY.

Tropical agriculture is faced with no new problem, and if, in what follows, attention is mainly directed to modern industrial methods, rather than to those of modern English agriculture, for a precedent and for a study of the conditions under which research and practice will go best in harness together, it is because British industry is solving the same problem in a way British agriculture, owing to the economic trammels which its history has wound about it, cannot. Industrial research, that is research with the express object of serving an utilitarian purpose, as opposed to pure research from which utilitarian results of supreme importance have arisen but in a fortuitous manner, as a recognised and vital component of industrial organisation, is of comparatively recent origin, a matter of little more than the last quarter of a century. Its history is well known and its experience readily accessible, lying as it does within the memory of the present generation. It owes its present recognition to the same forces that are now beginning to make themselves felt in tropical agriculture. Economic pressure, the result of competition under the more stabilised conditions established after the first flood of industrial revolution had spent itself, has demanded greater efficiency as the price of success. And the key to greater efficiency has been found in the better understanding of the principles underlying production.

The crux of the economic problem underlying the organisation of industrial research is finance. While the importance of research to industry is beyond argument, for modern civilisation is in being only as the result of research, the uncertainty attaching to the conclusion of any work directed to the solution of a set problem is well recognised. Research requires the financial methods of insurance, for the wider the net is cast, the greater the chance of gathering in the fishes. The set problem may be to catch a sprat, but the bag may be a whale, sometimes even a bit of drift wood. It is not, therefore, the plaything of the small industrial organisation with strictly limited financial resources.

PRESENT POSITION OF RESEARCH.

In the past industrial research has been conducted by means of endowments, a method more widely used in the domain of pure research and education; by Government agency; by trade associations, subsidised or not by Government, or by departments within the industrial unit or company. These are named in the approximate ascending order of degree in which control is vested in the hands of those who will derive benefit from the results obtained. The more indirect this control, the greater will be the scope for play of those forces which tend to a divorce between research and practice, and which have been outlined above. Undoubtedly, the most economic form of industrial research is that which is conducted by the unit of industrialisation, the company. But this conclusion carries with it certain corollaries. It has been noted that research, by its very nature, involves financial methods suited to insurance; involves, that is, large units. It is noteworthy that Lord Melchett, in a recent exposition of the process of rationalisation, includes this positively among the benefits "for the larger company can afford to risk an amount to meet unforeseen obstacles which would bankrupt an ordinary business." And what is research but organised meeting, often in advance—to use an Irishism—of unforeseen obstacles ? Rationalisation on these grounds alone, as distinct from its further, and, perhaps primary objects, the better correlation of supply and demand, appears justified, and the only manner in which the economic pressure of competition can be met.

Research associations organised on a trade basis have received much encouragement and support from Government since the War. They may be considered an adequate means of financing research; their efficiency in achieving the objects for which they were instituted is a separate consideration. They have been in operation for a period sufficient for opinions on their utility to crystallise. Here is the conclusion of the chairman of one of these research institutes :—

> A closer alliance between science and technology was needed if progress was to be made in the mills. Accordingly, the organisation committee had agreed to release some of the younger trained staff for service in the industry if any of the members applied for such assistance. There was the more necessity for the introduction of a larger number of scientifically trained men in the mills because it was unlikely that future discoveries could be brought to the point of economic production in the institute which could only point the way and do the laboratory work.

WIDER YET CLOSER CONTROL.

There is here no questioning the value of the work of the institute, but there is a very distinct opinion that the conversion of that work into mill practice falls short of what the effort might and would under more favourable conditions yield. It is a recognition that the conditions of a research institute do not fully counteract the inevitable tendency for research and practice to drift apart. He too turns to rationalisation as the cure for this tendency, for he says :—

> Yet I am convinced that for the rapid development of the industry larger and larger groups are necessary, if for no other reason than they could employ men of scientific training.

It is hoped that there is nothing in what has been written above which can, or will, be taken to belittle the work of the research associations, or, in fact, of any institutions engaged in research however they may be organised. They are serving an invaluable purpose, both in the work they are doing and, perhaps as important, in building up a body of scientific men trained in an industrial outlook. But there is still a long way to travel before research finds that niche in the industrial organisation in which its capacity to solve the problems with which industry is faced can be most effectively employed. It is as a factor within the large industrial organisation that results from rationalisation, and not as a distinct unit only loosely bound to the industrial machine, that research will find its fullest scope.

PAST THE PIONEER STAGE.

The history of tropical agriculture offers many points of similarity with the history of industrial development. If that history covers centuries in both cases as in the plantations of the West Indian Islands and in the early industrial companies in England, industrial development has forged ahead in its later development. The change dates from the industrial revolution, in full flood a century ago, in the one case; in the other, it is a matter of little more than a quarter of a century. The enormous expansion in tropical production which has taken place in this period, till production in many cases at times exceeds demand, has led to competition with an associated fall of prices which compels close scrutiny of the costs of production and the adoption of the latest improvements. Tropical agriculture is passing through the same phases as those through which industry has passed, and it has reached the stage when the prize no longer falls to the first in the field, but to the best mounted. History is, in fact, repeating itself. As with industry, rule-of-thumb is no longer a sufficient guide and research finds its place as a guiding factor for improvement.

Thus far the proposition has received general recognition. All tropical colonies and dependencies have devoted considerable energy to the study by research of the problems of production. And when the means by which financial provision is made are considered the same methods are found; endowment, Government agency, research associations and research departments within the business unit or company. In recent years there has been a tendency for a fifth agent to arise, the consumer or provider of agricultural essentials has entered the lists. But it is in the relative amount of energy contributed by these various agencies that the main difference lies, for the preponderating share is provided by government. Thus the major activities of research are carried out under conditions which, from their very nature, tend to divorce practice from theory. They are not the conditions under which the maximum will accrue from a given effort.

RATIONALISATION.

This is the stage at which the employment of research in tropical agriculture has arrived, and, large as have been the results obtained, it cannot be said that research has won for itself an undisputed field; the difficulty experienced in securing the necessary financial provision for research undertakings is sufficient indication that this is so. If industrial research has a long road to travel, it has at least established a secure position for itself. May not tropical agriculture, in following the same path, learn something from that experience? And that lesson lies in the recognition that, unless closely linked together as they will be within the business unit, research and practice will inevitably lie apart. Rationalisation of tropical agriculture must follow, if only to secure this advantage.

It will be well to follow up the implications of this conclusion. Agriculture, if the cattle industry be omitted, is the production of economic plants, and it is concerned with the relationship between these in all their variety and the soil and climate in all their different aspects. One of the first lessons the agriculturist learns is the need of rotations, the undesirability, even in cases the impossibility, of growing one crop continuously. Yet on what basis is tropical agriculture usually organised? It is a basis of a single crop. Even where the business unit is large and the produce of more than one crop handled, it will frequently be found that the crops themselves are localised and in no sense serve the function or rotation to each other. A condition where eighty, or even ninety, per cent. of the cropped area is under a single crop, leaving only a mere fraction for other rotational crops and fallows, is fundamentally unsound. It is unsound agriculturally, and it is unsound economically. Superimposed on the trade cycles which form a recognised feature of industry, and which are equally apparent in agriculture, are the seasonal influences which are largely beyond the control of the farmer and planter. Inordinate fluctuations consequently characterise the balance sheets of a concern based on a single crop.

But the matter does not end here. Many of the problems underlying plant growth are common to all crops; the problems concerning any particular crop are frequently specialised cases of more general problems. Much of the work affecting a particular crop has an application of a much wider bearing. Efficiency, or the economic employment, of research demands that the field over which it ranges shall not be too restricted or the aim too closely defined. Only with a wide field will the results find their appropriate application. Both demands arise from the similarity existing between research and insurance, of which the essence is that the net shall be cast wide.

ATTRACTING AND USE OF PERSONNEL.

To anyone with experience of tropical agriculture another aspect will occur, that of personnel. No one can be but struck with the paucity of trained research officers in the employ of private companies interested in tropical agriculture. Looked at from the point of view of the student who has to think of his future, the openings offering appear to offer little prospect; little in the present, for the pay of such posts as are available is rarely attractive, and little in the future for advancement. Even the more secure field of research under government has proved none too successful either in attracting the best men or in building up a contented service, for the recent schemes contemplate, besides an improvement in prospects to hold men in the service, a system of probationary studentships to attract men to the service. Research has, in fact, ceased to be mainly a hobby for those to whom material success in this world offers less attraction than the puzzling out of the conundrums of nature. Economic research has become a profession, and if it is to attract the best brains these must be drawn away from competitive fields of labour by the accepted business method of attractive conditions. And this is what a rationalised industry can do. It is one of the advantages that Lord Melchett claims for rationalisation that a large scale organisation can attract the best brains. It is true the army of experienced men is small at present; supply is regulated by demand and demand, in the past, has been fickle. But this need not be so. There is no room for argument as to which came first, the fowl or the egg. The fowl, in the shape of demand, must come first; the egg will certainly follow.

CONTRASTS WITH INDUSTRIAL SYSTEM.

Rationalisation is the one means of weaving research into the web of tropical development under those favourable conditions on which it depends for success, a sufficiently wide field, a close contact with practice and a sufficiently attractive reward for service. But it will differ from rationalisation as understood in industry in more than one respect. A rationalised unit will deal with a wide range of products for, unlike much industry, sound agriculture demands variety, the variety given by rotations. It will cover many countries for climate is a local phenomenon and an adverse season will affect adversely to a greater or less extent all production in the locality. So may, to quote Lord Melchett again, "the success of one section be used to finance another section." Any business subject to large vicissitudes is compelled to cut its cloth, in the matter of fixed charges, to the period of depression, and the provision for research, once made, becomes a fixed charge. The holding company, with subsidiaries embracing interests in a wide variety of products, and with a range extended over the globe offers the most favourable conditions for research and, because returns will be equalised, the surest means of financing such work.

RESEARCH IN THE SUGAR INDUSTRY.

A review of research in tropical agriculture as now conducted would seem to point to the same conclusion. Research is, perhaps, most highly organized in the sugar industry; it may even be claimed that it has gone so far that stabilisation has set in. But it will be noted that within this industry it is in the factory, where the problems are of an industrial nature that this progress has been made. Within any modern factory differences of a fraction of a per cent. in the recovery of sugar are the subject of close enquiry. Differences of 50, 100 and even higher per cent. are common in the field, but do not call for the same close enquiry. They are past and cannot be remedied. They are the seasonal response; but the exact nature of that response with a view to future adjustment, by artificial means, of the conditions to the optimum is not always closely followed up. Research

may point out the direction in which the adjustment is to be made, but the problems are so local that it can lay down no rule-of-thumb method universally applicable. The closest co-ordination between research and practice is required to ensure success.

And mention of the sugar industry calls to mind the Dutch work in Java. Here the agricultural side has been intensively studied, and by an organisation which approximates to a research association. Here appears at first sight a contradiction of the conclusion reached above. But the Javan conditions are peculiar. In the first place the system of land tenure ensures adequate rotation; in the second, the Javan sugar industry is conducted on intensive lines over a relatively small and uniform area very different to the extensive system commonly found in the tropical areas of the British Empire. The success achieved in Java undoubtedly shows what may be accomplished by a research association under the most favourable conditions; it affords no real proof that a similar organisation will bear like fruit under very different conditions. There are very strong reasons for doubting the correctness of any such conclusion.

For the reasons adduced organised progress in tropical agricultural production seems to demand a general broadening of the basal commercial unit "if only for no other reason than that they could employ men of scientific training," or, in other words, carry the charge of a well-equipped research section. It may appear to many that such a development will lead to redundancy, that the present research stations sufficiently cover the ground. To others, and especially to those who are associated with, or working in, existing institutions, the development may appear dangerous as likely to restrict still further the already exiguous financial resources. Neither fear would appear to be well founded.

GOVERNMENT SERVICES.

It has been customary to classify applied research according as it deals with what are termed *ad hoc,* or fundamental, problems. It is a distinction of degree, not of principle. These merely indicate loci in a complete series graded according to the remoteness of the particular problem from its practical bearing, and any attempt to draw a sharp demarcating line in such a series is not without danger. In fact, the series passes beyond these limits without material break, on the one hand into practice, in which the research element is restricted to the instinctive power of observation and deduction which any farmer must possess if he is to succeed, on the other into the realm of pure research from which practical considerations are entirely eliminated.

The history of the movement to apply research to tropical agriculture shows the movement to have been of gradual growth. In the early days, within the financial limits imposed, any degree of specialisation was hardly possible. The technical services, mainly organised by Government, were brought face to face with practical problems, and developed a practical bias. They crystallised into an organisation in which research was represented by a few specialist officers attached to, but hardly incorporated in, the organisation. With the growing recognition of research the tendency has been in the direction of the creation of separate research sections within the organisation, and, latterly, in the creation of independent research organisations. The impulse towards the latter is dual. In the first place, the average colonial administrative unit on which the government service must be based is too small to carry the charge of an efficient research organisation; in the second, many of the problems are common to several, or even all, administrative units. The policy is dictated by economy.

This tendency towards the concentration of research is not, however, without its disadvantages. A certain amount of competition gives a healthy stimulus in the mental, as well as in the commercial, field. But of greater importance is the divorce of research from practice which must result unless countervailing precautions are taken. Even when these are taken, there still remains a hiatus, not readily bridged, between the demonstration of the results of research and their adoption in routine practice. This failure to derive the full benefits of research is readily explained; partly it is economic, partly it is sentimental.

SENTIMENTAL DIFFICULTIES.

Assume that research succeeds in producing a variety of some widely-cultivated crop, a plant which is raised annually from seed, and which is readily cross-pollinated. The substitution of this plant for that commonly grown necessitates an organised seed supply produced under conditions which ensure purity. If the crop raised from one bushel of seed yields 25 bushels, a not uncommon rate of multiplication, this means that not less than 4 per cent. of the entire area under the crop is required for seed, and must be subject to the somewhat rigid conditions that ensure purity. The practical difficulties are obvious, but the major difficulty is sentimental, to secure the adoption of a common policy by a group of independent units. In such a case the fruits of research may well wither before maturing.

The same difficulty arises in the case of disease. Remedies for disease are frequently expensive; expensive, it may be, in material, as sprays, or expensive in labour. An external authority is, in such a case, very impotent. It may work by persuasion, in which case, inevitably, a certain number, through lack of financial ability or through indifference, take no effective remedial measures, and may thereby negative the efforts of their neighbours; it may work by compulsion as has been attempted by disease ordinances. But compulsion is far from satisfactory, and commonly ineffective. The London policeman is, probably, the only man who has solved the problem of the enforcement of restrictive law, while retaining the confidence of the community affected. The agricultural officer should be the friend; he cannot be this if he has to play the role of the policeman. The fruits of research may here, again, fail to mature.

IMPORTANCE OF STATISTICAL RECORDS.

If, then, the full fruits of research are not apparent through failure, as in these instances, to adopt proved results to practical conditions, the potentialities of research may also fail to appear for another reason. More and more is it becoming evident that a numerous class of problems, notably cultural problems, can only be solved by statistical methods, methods, that is, which require a large series of accurate and concordant records gathered under a wide range of conditions. Even the best equipped research station can hardly embrace the minimum range necessary, and is dependent in these cases on records independently collected. The area under its direct care is representative of the influence of a single set of climatic conditions, and it cannot be representative of the wide range of soil conditions found within its sphere of influence. The difficulty of securing data having the range and the degree of accuracy and concordance necessary if assured conclusions are to be drawn, when reliance has to be placed on a number of independent recording units, is self-evident.

It follows that the hiatus at present existing between research and practice reacts in a detrimental manner in two ways, and it is impossible to doubt that the increased practical output that would result from bridging the gulf can only result in emphasising the importance of the research institution and in strengthening its appeal. Again, there is no redundancy.

An efficient research department within a rationalised organisation concerned with tropical production is complementary to the independent research station bridging the gap between practice and the more fundamental research undertaken by the latter. The natural drift towards pure research now becomes an asset in the latter.

ACCOUNTANCY ESSENTIAL.

The functions of the research department within the commercial organisation differ from those of the research station in several important directions, and these arise from the closer association which such a department will have with practice. One of its first functions would be the collection of a co-ordinated series of data relating to all the pertinent factors of soil and climate as these affect the growth of the plant. This leads to accountancy; accountancy in its widest sense and not limited to pounds, shillings and pence; accountancy which deals besides with the unit of cultivation, the field, and records in detail cultural processes and particulars of crop growth and yield. Accountancy in this sense is already adopted on some progressive estates, and it is hardly too much to say that it has been in more than one case the deciding factor between success and failure. But co-ordination between different estates is lacking. Usually, too, the accountancy systems are drawn up with little regard to the possibility of subsequent statistical analysis. But if the benefits have been great from this limited application of accountancy, these benefits are as nothing to those which would accrue from a co-ordinated system applied on a world-wide basis and drawn up by trained officers who have in mind the subsequent analytical process.

Such a system of records is itself the basis of generalisations, but it is also the essential requirement for the practical interpretation of the generalised conclusions of more fundamental research. A central research station cannot, as has been indicated, control the wide range of conditions found in practice. In many matters it can only generalise, and the further problem of interpreting these generalisations country by country and even field by field is raised. An agency with greater local knowledge is required to reduce generalities to practice.

TRUE USE OF GOVERNMENT RESEARCH.

The tropical agricultural research stations now being organised throughout the Empire have, in this aspect, a very important function. They find their place in work comparable to that done by universities and endowed institutions in England; institutions that are practically non-existent in the tropics. But as such, they require an intermediary, an interpreter, of their results for they cannot alone, from the diffuse nature of many of the problems, adequately link up with practice in general. They will serve a second purpose in forming training grounds to add to the present small number of men "of thorough scientific training, temperament and enterprise required," in the words of Prof. Bone "for the recruitment of higher management." If the strenuous period which lies ahead of tropical agricultural development as the result of competition is to be met successfully full use of the results of research must be made and the means to achieve that use must be adopted. Is it necessary to wait, as industry has waited, the compelling pressure of economic forces to make adequate provision ?

In recent years there has been a steadily growing recognition of the importance of tropical agriculture as a field for applied research. The necessity of organising the conduct of that research so that the full practical return may issue therefrom has hardly received the same degree of consideration. By the means outlined in these articles research will be brought

into that contact with practice which is desirable and even necessary. There remains for consideration the question as to how far a rationalised organisation on these lines will itself have sufficient contact with field practice to ensure the practical incorporation of the results of research.

VARIETY OF OWNERSHIP SYSTEM.

The systems under which tropical agriculture is now conducted are various. At one extreme may be placed that system found in those areas which are adapted to white settlement. In these the English ideas with regard to land tenure have prevailed and land has become recognised as a personal asset. Here the essential features of English agricultural conditions are reproduced, and here will be found the same difficulties as are apparent in England, difficulties arising from uneconomic holdings, from lack of capital, from unorganised marketing and from differences in personal outlook.

Such areas, however, occupy a relatively small, though actually large, portion of the tropical land zone. They are mainly concerned with the raising of produce which requires a minimum of capital in the form of machinery to render it marketable. In the next system a company replaces the individual. The company, instead of the individual, holds the land, and by means of a labour force raises and handles the crop for the market. The system is particularly adapted to crops like sugar which require a large capital outlay for the manufacturing process or for crops like rubber and tea, in which a considerable period must elapse before a return comes for the capital invested. It is typical of those countries of which the climate forbids a permanent home to the white man. It is here that rationalisation can be most readily affected for the basis of organisation approximates to that of an industrial concern.

But frequently this system which in its purity consists of a self-contained unit working within the bounds of its own properties passes into a more complex one. In this, by a series of arrangements too diverse to receive illustration here, the company secures control over a larger supply of produce than can be raised from its own lands. It enters into contracts with its neighbours for the growth of specified areas of the crop in which it is interested and takes over the produce. As a variant of this in one direction is the tenant farmer system under which the cultivable area is leased out in small units to cultivating tenants under a contract to grow a certain area of the approved crop. In the other direction the area under direct control is reduced even to vanishing point and, in extreme cases, the company becomes merely a trading company interested only in the marketing and grading of certain classes of tropical produce.

The deciding factor here is frequently a question of population. In British possessions the adoption of suzerainty over a tropical area is followed by efforts to determine personal rights in land and those lands alone of which no such rights can be established fall to the Crown for disposal on such terms as may be determined. Where a dense indigenous population is found claimants are forthcoming to all the fertile lands and the Crown lands are limited to the less fertile. Historically, too, a great change has taken place in the attitude of the suzerain power in the matter. The disregard of local rights typical of the early adventurers and involving a negation of any right in land to the conquered, has passed through the stage of impressing the English system of land tenure to the full recognition of native custom which, in many cases, accepts tribal ownership or spheres of influence in all land. In the extreme case there is no land available as Crown property and at the Crown's disposal. In these cases the alien is restricted to trade or, at best, to a qualified possession of land by arrangement with the tribe under limitations imposed by Government.

THE MAIN PROBLEM.

These cases which in all their variant forms range from the company with full ownership of land to the trader, offer a more complex problem. But it is the major problem of tropical development for they represent the conditions in the vast majority of the territories now being opened up. The problem is to apply the knowledge acquired by the progress of science in its application to agriculture to a number of independent small, scattered, generally backward and certainly financially weak units. It is a problem that must be solved if the progress of the country as a whole, and the standard of living of the individual within it, is to be raised; it must be solved if the increasing world demand for tropical produce is to be met. The produce enters the world market and has to meet world-wide competition. Quality is, therefore, important, and quality is not merely a question of grading; it is a matter of uniformity of variety, of high standard of cultivation and of care in preparation. With the rapid progress in recent years in the consumption of tropical agricultural produce demand has normally exceeded supply and such produce has found a market free from excessive emphasis on quality. But this period is passing, if it has not already passed. Competition is becoming intensive, and it is competition between a crude native product and graded plantation product. Despite the anomaly presented by rubber at the present moment, there can be no doubt which, in the long run, will secure the limited market.

How, then, is this problem which lies at the root of colonial progress to be solved ? It cannot await solution till the local moral, material and educational standards are so raised that the stimulus will come from within. He would be a rash man who set a time limit for that millennium, and meanwhile the world will not stand still. Rather in that solution should be sought the means for raising the local standards. It cannot be solved by government agency alone. The limits to the activities of an Agricultural Department are well defined. In the rarest instances can it adopt compulsion and it must rely on persuasion as its chief weapon. But, as experience shows, persuasion, to be effective, requires a degree of intimacy which is impossible with any reasonable personnel. And even if these difficulties could be overcome there still remains the financial problem for the small cultivator has not the necessary resources for any progressive system of agriculture such as science is likely to recommend. In these cases particularly there becomes apparent the need for an intermediate agent having the financial resources and the knowledge at its disposal and in a position to establish that intimate relation with the actual producer which is the secret of success. And such an agent is to be found in a rationalised organisation such as these articles have outlined.

That development may proceed on these lines is undoubted; that these are the most promising, and even the only, lines on which real material progress can be made is a claim that may be advanced with a considerable degree of confidence. But much will depend on the spirit in which the subject is approached. It is a spirit which recognises a partnership in production, a triple partnership between the cultivator on the one hand, the government as representing the community, and the commercial organisation.

But the limitations imposed have a world basis. Capital has a value which is determined in a world market and it will flow to that quarter where the return relative to risk is greatest. If, therefore, the movement is to succeed, conditions must be such that the return has every prospect of materialising and undue risk must be avoided. Too often in the past the security has been the land itself, but, from the very nature of the problem, land adequate to give the required return from its own productive

capacity is not here available. What is essential is direct control over a sufficient area both to regularise supplies of the raw material from day to day where a factory process is involved and to work out all problems connected with production. What is also necessary is a demarcation of spheres of influence by contact or other arrangement which will ensure that the bearer of the burden of development will reap the reward. But security to one party must not be bought at the expense of the other and if freedom of market is withheld to the producer he requires adequate protection against exploitation. To hold the scales in this matter is the function of the government.

The problem can, and will, be solved, and it will be best and quickest solved if approached in a co-operative spirit; with the recognition that three interests are involved. The problem is not entirely new; already, apart from the cane farming system found in some countries under which advances are given for a lien on an area of cane promised to the factory, there are practical efforts towards such a solution, notably by the Dutch in Java, and more recently, in the Sudan in which latter the triple nature of the partnership is clearly indicated. These point the way; but the very divergencies between these two systems indicate to what extent local conditions and the peculiarities of the various crops grown may modify the actual form of the scheme. The principles, however, are clear, and it is the administrative problem to adapt those principles to local conditions in such a way as to foster progress.