

CACAO

Introductory.

During my recent sojourn in Trinidad I was fortunate in seeing different cacao grown under different conditions and methods of cultivation, and in being able to discuss the scientific aspects of the tree itself and its origin. After a lapse of a year, I thought it might be of interest to write a few notes on what now seem to be the really important points learnt in Trinidad and elsewhere with special reference to their bearing to Nigeria. This also affords an opportunity of giving a brief summary of the work on cacao cultivation and breeding that the Department is trying to do. What amazes me most has been the refusal of countries dependent on cacao to adopt scientific methods of research. Except for manurial trials started five years ago in Trinidad, no agricultural problem connected with cacao has been subjected to even reasonable scientific investigation. For over 50 years Shade v. No shade has been the topic of violent argument. The experiments on shade at INA (Nigeria) are the first in the world to have been reasonably laid down to test this point. Since cacao cultivation started, more than a hundred years ago, attempts have been made to improve the type of cacao; the progeny trials in Nigeria are the first in the world where control pollinated seed has been used.

There is a feeling that in Nigeria the native farmer knows best - so why worry? Mr. West and myself have seen thousands of acres of land in the Gold Coast, which we were told was once flourishing cacao, and is now abandoned land with scattered derelict trees. The same is beginning to happen in Nigeria. If we can't even attempt to improve on a method of cultivation to which that is the answer, we might as well pack up being an Agricultural Department.

General cacao world survey.

Whether we like it or not, the South Western Provinces are becoming more and more tied up to cacao. There is no need to emphasize the wealth brought in and the effect this is having on the organization of the people and their standard of living. But there seems to be rather an appalling lack of knowledge about cacao, and we as a department are least of all capable of giving any advice.

I have been tempted to start off with a general survey of cacao production in the world to show what may be expected if we continue to bury our heads and allow the cultivation of cacao to proceed along its own sweet way; an examination of production in other countries may give inferences from which we can draw. The following table is only approximate but accurate enough for the purpose. Figures are in thousands of tons of 1000 kilos.

Group I.

Countries where cacao has been cultivated for about 100 years or more.

| | 1915 | 1920 | 1925 | 1930 | 1935 | Price +/- cents per lb. |
|------------------------------------|------|------|------|------|------|-------------------------------|
| ECUADOR | | | | | | |
| (Guayaquil and arriba cacaos.) | 56 | 43 | 27 | 16 | 24 | +1/4 |
| VENEZUELA | 18 | 18 | 23 | 15 | 14 | + 1/4 |
| (caracas cacao) | | | | | | |
| SURINAM | 1 | 2 | 1 | 0 | 0 | -1/8 |
| DOMINIQUE REPUBLIC | 20 | 23 | 23 | 18 | 16 | ?-1/2 |
| TRINIDAD | 25 | 28 | 22 | 17 | 13 | +1/4 |
| GRENADA | 5 | 6 | 4 | 4 | 4 | +1/4 to -1/8 |
| JAVA | 1 | 1 | 1 | 2. | 2 | +1/4 |
| CEYLON | 4 | 15 | 3 | 4 | 3 | +1/4 |
| S AN THOME | 28 | 20 | 21 | 10 | 10 | 0 to -1/2 |
| | 158 | 144 | 125 | 86 | 82 | |

Group II

Countries where cacao cultivation is recent.

| | | | | | | |
|------------------------|-----|-----|-----|-----|------|------|
| BRAZIL(Bahia cacaos) | 45 | 57 | 65 | 70 | 120 | 0 |
| PANAMA & COSTA RICA | 1 | 3 | 6 | 10 | ? 15 | -1/2 |
| FERNANDO PO | 4 | 5 | 6 | 8 | 12 | ? |
| IVORY COAST | 0 | 1 | 6 | 25 | 49 | 0 |
| GOLD COAST | 79 | 127 | 217 | 200 | 290 | 0 |
| NIGERIA | 9 | 17 | 42 | 59 | 92. | -1/4 |
| | 138 | 210 | 342 | 372 | 578 | |

French Dahomey, French Cameroons, Belgian Congo omitted. No figures available, but they do not amount to much.

As a generalization the exports from the old countries have been steadily decreasing and that from the young countries rapidly increasing. Just the same thing happens with each individual field of cacao. The question at once arises how much longer is Nigeria going to stay in Group II and keep out of the economic crashes associated with those countries in Group I where cacao plays a prominent part in

producing revenue. We do not know the answer. But we do know that if new planting ceased, within a very few years we should be thrown into Group I. We have very little idea how much more land is available for cacao planting, but it is reasonable to assume that there is a fixed limit which we shall be approaching sooner rather than later, because cacao will not grow unless soil and climate are just right for it.

Inevitably tied up with production is price. In the detailed investigation of price there is a tendency to overlook several remarkable facts. The price realized for the bulk of the cacao produced from the countries in Group I is one and a half or twice the price per ton realized from countries in Group II. In spite of this the exports from Group I are declining. In the young countries there has been a constant squeal over the last nine years (with the exception of 1937) that the price of cacao has been too low and that there has been no money in the business. In spite of this we have no evidence that the rate of new planting has decreased. On the contrary, from general observation, farmers in Nigeria and in the Gold Coast have continued throughout this period a policy of vigorous planting. So we cannot say that price is the fundamental factor governing the increase or decrease in production.

The figures in the last column give a rough idea of the relative values of the different cacaos. The figures are taken from the New York Cacao Exchange (April 1939) and represent the increase or decrease over the standard (Accra or Bahia main crop) which purchasers have to pay.

Nigeria does not control the price of cacao on the world's market, and therefore this country has to face competition. Lost in a sea of argument over price is the one rock which producers will not cling to. This is efficiency of production. Where there is competition only those who are really efficient producers can weather the storm. Are we satisfied that cacao production in Nigeria is making full use of what science can offer? Do we even know what Science can offer? It is worth digressing a moment to consider the Eastern Rubber industry. This enormous industry was founded when rubber was 10/- a lb. In 1932, and in depression years previous to the Restriction Scheme the price was frequently below 4d a lb. Even then the efficient companies were able to make a profit because they made the utmost use of scientific methods. There is not a rubber company report to-day which does not give prominence to programmes of cutting out old trees and replanting, and, of manuring. And every new tree planted is of a proved superior strain.

One other little digression on efficiency. I met the, Director of Agriculture, Trinidad, showing a Dutch Agriculturalist round River Estate. Dutchman, "In Java we now only use budded plants of Coffee, Rubber, Tea, Quinine, Cacao, Citrus. Except for citrus I notice very few budded plants in Trinidad. D. of A. "Budding is expensive and we cannot afford it". Dutchman, "So, the same expense in Java, but Java is a small island and we have to be efficient." To which no reply was forthcoming.

It has already been mentioned that the price per ton of cacao from Group I is nearly double that of Group II. This is because the type of cacao grown in Group I countries is superior. It has also been hinted that efficiency of production is in part determined by the type or strain of tree grown. Uganda tried its hand at producing cacao, but the trees, although growing well never yielded, presumably because they were sterile strains. So this leads on to the next question. What are the types of cacao? This in turn means we must not be frightened of delving; into the realms of genetics.

Types of Cacao Grown.

The current theory is that there are four well recognized species which go to make commercial cacao. If any one of these were grown from seed (self fertilized or crossed with pollen from a tree of the same species) they would come up exactly true to type. These four species are:

- I. Nicaraguan Criollo. Yellow pod, warty, pointed, collar, medium size. Very thin husk - can be squeezed in when ripe by hand. Beans very large, lozenge shape, pure white in cross section.
- II. Venezuelan Criollo. Red pod, smooth, no collar, medium ridges or furrows, much larger pod than Nicaraguan, not markedly pointed, thick husk. Beans very large, slightly flat, pure white or pinkish in cross section.
- III. Cacao Nacional (Ecuador cacao). Red pod, very warty, slight collar, long and oval. Beans large and pale in cross section.
- IV. Leiocarpa. (Formerly called Amelonado) Yellow pod, smooth, slight point, slight collar, medium size, medium husk thickness. Beans small, rather flat, dark purple in cross section.

Then there is a large group of cacaos known as the Trinitario Complex- (formerly Forastero. This group includes all hybrids brought about by the inter crossing of any or all of the above four species. A Trinitario tree may have enormous pods with very small purple beans, or small pods with large pale beans. You do not know what you're getting with a Trinitario tree, and seeds taken from such will not breed true. A useful homology may be taken from the human population of, say, Trinidad. There are several human species in that island -- Chinese, South American Indians, Hindoos, West African natives - Europeans and probably a few more. These have intermingled, and a large proportion of the population show every divergent genetical characteristic, and might equally be called the "Trinidad complex". The homology breaks down on one important point. A high proportion of the Trinitario Complex" cacao hybrids shows various degrees of sterility which, of course, reduces yield. No such sterility appears to be present in the human hybrids.

The rather uninteresting descriptions of these four species of cacao and of the Trinitario Complex may be enlivened by a few notes on them.

Nicaraguan Criollo has dropped out of the picture almost entirely - probably because -it has the reputation of being a delicate plant. I have only seen a few seedling trees in Trinidad and Tobago, but one estate of about 120 acres was planted in Tobago with budded Nicaraguan Criollo. Although only four years old the budded trees looked in excellent condition. The owner of this estate had obtained budwood from a few trees he discovered on a neighbouring estate. Having proved how well his budded trees were doing, he offered to sell exclusive rights of taking planting material from his trees to the Trinidad Government. The price asked was the paltry sum of \$250,000 : The offer was turned down as Government- soon found the original trees on the other estate which he had used, and this owner had no objection to supplying as much budwood or seed as required for nothing.

Budded plants of two similar trees are at Kew awaiting transference to Nigeria.

The manager of the budded estate claimed he got £100 a ton for his Criollo cacao (Nigerian was then at £20 a ton), and he said it had a special use in coating certain kinds of chocolate biscuits. As the quantity sold could not run into more than a few tons the whole position is doubtful. But the fact remains that this Nicaraguan

Criollo, requiring only one day's fermentation, will always get an enormous premium over ordinary cacao. It has, of course, never been tried in West Africa.

Two other points of interest. His budded trees growing at the edge of his estate next to Trinitario trees had purple beans instead of pure white. This is because the Criollo flowers were fertilized with Trinitario pollen, and cacao beans (being cotyledons) show xenia or the characters of both parents. If Criollo trees are propagated by seed, the tip of each bean has to be cut off and only the pure white beans planted. Secondly, Nicaraguan Criollo has a different habit of growth and only shows the opposite and alternate arrangement of leaves as on the branches of other cacao species. The jorkette, or Swizzle stick, is absent. Nicaraguan Criollo seedlings can therefore be spotted within 8 weeks of germination.

II. Venezuela Criollo. I have only seen pickled specimens of pods of this species, but most manufacturers will proudly exhibit specimen bottles of Caracas Cacao which is produced from this species. The beans are very much larger than Nigerian cacao, and the price very much higher. This species used to be the only type grown in Venezuela, but estate owners, always hoping for something better, introduced Trinitario trees. In this case they presumably wanted a more hardy variety - one which would yield and grow as well as their own Criollo but which would require less cultural attention. As a result of these Trinitario introductions, the general quality of Caracas Cacao has undoubtedly fallen, but the replacement of the pure Criollo trees by these hybrids seems to show that the hybrids are in fact better able to withstand adverse conditions, but equally their yield may be smaller on account of this incompatibility business.

Venezuelan Criollo went to Ceylon and Java when those countries first started in on cacao. Both places seem to have been a bit dissatisfied, although the cocoa they sold was equal to the best in the world. One can only assume that they, too, wanted to get hold of a type of cacao which would not be so difficult to grow. Trinitario introductions were made many years ago, and descendants of those have replaced the pure Criollo. It is doubtful if those countries are really better off as a result of their Trinitario introductions; yields are certainly very low, and the quality of their cacao has deteriorated.

Nigeria wrote some years ago to get seedlings of this Venezuelan Criollo. Pods were actually sent from Venezuela to Trinidad for this purpose, but they all arrived hopelessly rotten. We shall have to await another opportunity. It has of course never been tried in West Africa.

III. Cacao Nacional. The commercial product is the highly priced "Arriba" or "Guayaquil" cacao. The only knowledge I have of this is from Dr. Pound who toured Ecuador recently. Just the same is happening to it as has happened to the Ceylon and Java cacaos and is happening to Venezuela. About twenty years ago, the Cacao Nacional went down badly to a monilia pod disease. In carne the Trinitario trees on the belief that these would not be so badly attacked. About twenty years ago Cacao Nacional went down to witch broom. In came yet more Trinitario introductions. I understand that the Trinitario trees have gone down just as badly to these two diseases, and Ecuador Cacao has consequently been deteriorating in quality.

Cacao Nacional has of course never been tried in West Africa.

IV Leiocarpa. The last on the list of pure species, but the most important since it is the kind of grown in all the countries in Group II. It is also grown in Grenada, Surinam, (before it all died out) and to some extent in San Thome.

Seven years ago, a certain Dr. Myers was exploring the back of beyond inland of the Guianas. He found some cacao trees in the primeval forest and brought back some pods to the Imperial College of Tropical Agriculture. Eight trees were grown from these seeds and were fruiting in 1937. These trees were to my mind identical with the type of cacao growing in West Africa. All eight trees were producing exactly similar pods - what, one would expect with a pure species growing about 200 miles from any other variety of cacao. Seeing these trees was rather like attending Crufts and suddenly finding a cage of Ado Ekiti dogs.

It was interesting to note that these *Leiocarpa* trees were not growing as strongly as certain Trinitario trees of the same age, but they were yielding well. They were the only *Leiocarpa* trees I saw in the whole of Trinidad.

In Grenada, about 80% of the trees are *Leiocarpa* (the high Grenada yields have always been a thorn in the flesh of Trinidad planters). But owners have from time to time introduced Trinitario red pod trees, hopefully thinking they were introducing the true Venezuelan Criollo. But there is little land left for new planting and the excellent standard of cultivation adopted in Grenada means that little supplying of old estates is necessary. So Grenada will have to stick to its *Leiocarpa* and enjoy the high yields, but complain of the low prices, associated with it. *Leiocarpa* also forms the bulk of the Brazilian (Bahia) crop. No one knows much about Brazil, but the old story seems to be happening there. Appreciable introductions of Trinitario have been made, and this will probably mean an eventual grading up of their exports. I was told by an agent in the Gold Coast, who had previously worked in Bahia, that the estate which he was supervising consisted mainly of trees unlike the West African type (*Leiocarpa*), and that the estate commanded a higher price for its cacao than the normal Bahia quotations. A broker told me that Bahia cacao poor stuff - but a bit more uniformly poor (owing to uniform fermentation) than West African, and that accounts for the small premium it gets on the English market over Accra cacao.

As has already been mentioned, we consider the West African type of cacao, formerly called Yellow Pod Amelonado to be, in fact, *Leiocarpa*. And exactly the same thing has happened in the Gold Coast and in Nigeria as has occurred in Grenada and Brasil. From the word go our respective Departments of Agriculture looked with envy on the higher prices to be obtained by growing a kind of cacao superior to *Leiocarpa*. Hence the introductions of Trinitario cacao to the old botanic gardens at Ebute Metta, to the Model farm at Agege and to Moor Plantation, all about 30 years ago.

Forty five years ago the Gold Coast did likewise only they had bigger ideas, and not only introduced Trinitario trees (the gamut of Cundeamors, angoletas etc.) but also Criollos. Unfortunately these Criollos were that, only on the headings of their record books, and were, in fact, just better grade Trinitarios. All their introductions came from Trinidad, and I was fortunate in meeting the man who chose the trees, picked and sent off the pods. I was therefore able definitely to check this point. Nigeria was not so ambitious in our introductions which can only be traced to the Cameroons - the Germans had plumped for Trinitario cacao on all their estates. Our introductions were very poor, little better than *Leiocarpa* itself. All the same considerable distribution of Trinitario seed did take place and can easily be noticed in the number of Trinitario trees on native farms round Agege. The Gold Coast also distributed large quantities of seed from their Trinitario trees. A surprisingly large number on native farms has recently been discovered, though

these would be second or third generation with a good dose of Leicarpa in them. The opportunity, of selection work among them is not being missed.

But the fact remains that the Trinitario types have not really caught on in West Africa. There are two main reasons for this. First, no inducement has ever been given to a farmer to sell "quality" cacao separately. Even if a farmer grew only Nicaraguan Criollo he would - under the present buying organization - get just the same price for it as his next door neighbour growing Leiocarpa. Secondly the partial sterility associated with Trinitario trees reduces yield, and the necessity for cross pollination insures its being swamped out in one or two generations if Leiocarpa trees are adjacent. As an analogy, it would not take long for our Ishan Cotton to become "Native" Cotton if we neglected to provide and regulate an annual pure seed supply.

No further introductions of Trinitario cacao have been made (except by us in the last four years) into West Africa since those original ones.

V. The Trinitario Complex. (Forastero trees). This hybrid mixture is a jumble up of the four species. And individuals in the mixture may be excellent or poorer than any of the species. Trinitario trees won't breed true., There is a regrettable, but- well understandable habit of judging cacao by the type of pod it produces, and not by the type of bean - which after all is what one sells. Thus a Trinitario tree may have pods just like Nicaraguan Criollo, but the beans inside may be small and purple - possibly even smaller than Leiocarpa. This caused the undoing of the introductions into Grenada and the failure of the Gold Coast Criollo introductions. Add to this the fact that nearly half the Trinitario trees set pods only as a result of cross pollination and confusion becomes worse confounded. Half is probably a low estimate. Of the trees I worked on in Trinidad 75 were self incompatible and in the Gold Coast, some 90% of the original Trinitario introductions were also found to be so.

To give some idea: of the variability within the Trinitario complex, certain trees require 60 pods to make 1 lb. of dry cacao others only five; and of course every gradation in between. Leiocarpa takes 12. Similarly beans smaller than Leiocarpa may be pure white, while the largest Criollo size beans may be very dark purple.

Again I would like to stress that self incompatibility - so common in Trinitario trees reduces yield. While the fact that the bulk of Trinitario trees yield only as a result of cross pollination has been proved, no one knows for certain what the agents of cross pollination are.

A final point - Calabacillo cacao is now considered a segregant in the Trinitario Complex and not a true species.

Summary of present situation in respect of cacao varieties.

No country has been satisfied with what it started with. The Leiocarpa countries - Brazil, Grenada, West Africa have tried to raise the quality of their cacao by introducing Trinitario trees. And at the moment have failed. The highest quality cacao countries, Ecuador, Venezuela, Ceylon, Java, have tried to raise the standard of hardiness - ability to withstand adverse factors which include resistance to certain diseases, and to show greater vegetative vigour - by also introducing Trinitario trees. These countries have partially succeeded, since it is generally assumed since it is generally assumed that without these introductions their own species would have died on them. But they have lost out on yield, and the quality of their cacao beans has deteriorated.

It is therefore not surprising that there has been a gap of some 25 years in which individuals and governments have been scared off attempts to alter what they already have.

The Changing Situation

In 1930 cacao research started in Trinidad. West Africa murmured disapproval considering that the Gold Coast or Nigeria should be the centre of this work. But there is no doubt whatsoever that Trinidad was the right place.

The whole basis of plant breeding is the collection of all available species and varieties, jumbling them up by intercrossing them in every conceivable way and then spotting the winners. The next stage is to get the winners to breed true to the desired commercial characteristics, or sufficiently true to make a definite improvement on the crop.

In Trinidad the intercrossing of Venezuelan and Nicaraguan Criollos and Leiocarpa has been going on for hundreds of years, and now the cacao population consists entirely of hybrid trees (Trinitario). Nature has done the first step in cocoa breeding. Spotting the winners was the first work Cacao Research started, and this has now been completed. The last stage of stabilizing the commercial characteristics was considered too difficult as long as the winners had to be reproduced by seed. Research therefore left this final stage of cacao breeding severely alone and unfurled the flag of vegetative propagation to stabilize the winners.

Unfortunately, Research was not too clever in making its selections. Probably at least half of the 100 made are self-incompatible and therefore should not be touched at end of a barge pole. It has been mentioned before that introductions of Trinitario trees have turned out badly because of this incidence of incompatibility. And again when Nigeria did get seedlings from a few of these selected trees four years ago, no endeavour was made to send controlled pollinated seedlings.

If after concentrating on selection and Research for five years in Trinidad, a fully equipped organization makes such howling mistakes as these in the years 1930-35, can individuals be blamed for not producing the goods in the 1800's?

Part II.

What we are trying to do.

There are two main directions along which the Department is going in order to safeguard the Nigerian cacao industry. The first is purely agricultural, the second, plant breeding.

Agricultural. There are three main problems.

a). How to keep good farms from deteriorating.

b). How to bring back farms which are already deteriorating

c). How to re-establish cacao on farms where it has completely died out. The first we haven't tackled at all. The second and third are now receiving attention. We have always been terribly short of the means of doing this work, and during the last several years it has been confined to dead or dying areas of cacao at Moor Plantation, Ajia and Agege. The total area is under 12 acres. It is of course realized that work on this scale is all too small, and Agricultural Officer, Oyo, has put up proposals for greatly extending it. The essence of the scheme is to acquire 30 acres of native cacao in each of the following Provinces: Ondo, Abeokuta, Ijebu, The Colony. Ten acres, divided into five scattered plots of two acres, of good, of dying and of dead cacao will be the basis of this experimental work. These plots will be

similar to the "Unit cacao farms" which the Gold Coast has initiated. By means of sanitation, supplying cacao seedlings in vacancies, and by the adjustment of shade - later coupled with the use of artificials and F.Y.M. - it is hoped to prevent further deterioration and to bring back derelict farms to good yielding capacity. Similar work is meeting with success in Trinidad.

A scheme has also been put forward for carrying out a survey of where cacao is grown in Nigeria, the approximate age and condition of the farms, and the amount of available forest land left for new planting. To do this would require three new European appointments.

That is what we hope to do. Now for what we have already found out.

I. Supplying. Where cacao has once grown well it is possible to supply seedlings with success in those gaps where individual trees or groups of trees have died out. This sounds almost too easy and obvious, but the fact remains that very few Nigerian farmers adopt this practice. In parts of the Gold Coast annual supplying is always done, and an old farm will contain trees of all ages. From what I have seen the Gold Coast annual supplying is better done than on Estates in Trinidad. A Nigerian farmer gives the impression of watching his farm deteriorate year by year and of doing nothing about it. Actually he is probably starting new farms elsewhere as hard as he can; but this is exploitation in its worst sense. We are not satisfied we know yet the best technique for supplying. We have assumed that the gaps should be first filled in with any plants which will give a cover to the ground and supply shade for the cacao seedlings. Such shade plants must be controllable - i. e. able to withstand cutting back in the wet season. Adopting these methods has worked, but there will may be easier ones.

II. Shade. On really poor sandy soils (the Red, pod plot at M.P.) overhead shade (rain trees) is definitely beneficial. That is all we are certain about. Proper shade tree experiments have been laid out at INA, and young cacao immediately under immortels looks better than cacao trees growing only with temporary shade. Our experience strongly points to the need of overhead shade in the dryer areas, but we have no conclusive proof. A whole range of different types of shade trees is now under trial at Moor Plantation and Ina.

Why not leave the big trees when starting a farm from forest? This is done over very large areas in the Gold Coast. We are hoping to try this method at INA, but we don't know what snags a Nigerian farmer might meet if he left the big trees. Local food crops, yams, corn and cassava are of vital importance - in the economics of starting a cacao farm; overhead shade might seriously reduce the yield of these. At Owena, a farmer told me that forest trees left after clearing, had a harmful effect on cacao and increased the amount of black pod and decreased the total number of pods.

III. Cultivation. As far as cultivation is concerned we have found that thinning mature cacao has led to disastrous results. Ten years ago it was thought that the density of trees on native farm was far too high. That may be true, but the remedy is not just to cut out a number of trees, since this results in the rapid deterioration of the remainder. Exactly the opposite of the Palm Grove improvement results. The thinning of cacao trees 4, 5 or 6 years old is commonly practised by farmers; the danger of thinning apparently only occurs when trees have reached maturity.

We have tried superphosphate on mature trees over several years without any visible effect.

We have tried grass mulching for two years, and this has worked well. It led us on to the possibility that the water content of these soils in the dry season was the

determining factor whether cacao trees would die back or not. If we can find out the fundamental causes of deterioration in cacao farms, we can base experiments accordingly.

Replacing old trees by suckers is a recognized procedure in Trinidad, and is working well when tried here. A strong sucker will bear pods three years before a planted seedling. It is essential to earth up the sucker to allow it to make its own roots.

IV. Establishment. On establishing cacao we are gradually working out a technique, having made disastrous errors in the early years. If we had been able to adopt native methods we would have had better cacao on our experiment farms, but we would have learnt little. Our main errors have been alternatively too little and then too much shade; but the greatest error has been in our actual method of planting. We started by sowing seedlings in nursery beds and transplanting into the field the normal way. Losses ranged from 35 to 50%, so we gave up that method and adapted basket planting. This reduced losses, but resulted in very poor growth of the plants. The poor growth was ascribed to insufficient shade (which was probably already more than adequate) and every effort was made to increase the amount of temporary shade. What appears now to have happened has been this. The earth between the basket and the sides and bottom of the hole was never properly consolidated at the time of planting. That has meant that gaps have subsequently formed underground between the main tap root and soil proper. No consolidation has taken place even after three years. Sickly cacao plants of that age have almost invariably been found to have this loose pocket of soil underneath them. It is probable that root diseases, which normally would amount to very little, have been given the opportunity of functioning.

I was unkindly pleased to see a Trinidad planter of long experience lose 50% of seedlings in trying to establish cacao plants raised in baskets, a method with which he was unaccustomed. For just the same reason - insufficient packing of earth at the time of planting. Mr. W. S.E. Barnado, one of the mining Engineers, and cacao planter, suggested the cause, and his advice put into practice has had very agreeable results. Now the soil round each basket is beaten in with wooden pestles, so that the basket is planted just as if it were a gate post.

We undoubtedly ought to have started off cacao work with finding the best method of establishment, but then we never anticipated any difficulties. We have since learned that within the last ten years the Gold Coast Department has had various attempts at establishing small cacao progeny trials, but have consistently and completely failed. Methods of establishment are the next thing on the agenda for us to try out as soon as land and money become available.

Two Serious Diseases.

Sahlbergella Bugs. During Mr. West's and my visit to the Gold Coast we were enormously impressed with the amount of damage done to cacao trees of all ages by this bug in the wetter areas. Farmers in the Gold Coast now reckon it takes ten years to bring cacao into bearing as opposed to four years, because their young farms have to be left in bush as a protection against Sahlbergella which has also been a major factor in destroying thousands of acres of old cacao. The damage is estimated at £1,000,000 per year and appears to be more important than witch broom disease in America. The Gold Coast farmers know all about Sahlbergella, calling it Sankonuabe, which means "Go back: to your Oil Palms". Just the same

damage is beginning to become evident in the wetter parts of Nigeria. At Owena plantation nearly a quarter of the young trees would have been killed had we not adopted hand picking to destroy the bugs. I have never met a Nigerian farmer who recognized Sahlbergella. When shown patches of cacao where it was doing wholesale destruction, farmers have always me that was due to underlying rock. Apart from hand picking which is only practicable on young trees, we know of no control measures.

Black Pod disease: This hardy perennial probably accounts for 10 to 20% of the crop each year depending on the season. A practical control, through regular 3 weekly harvesting and the removal of all diseased nodes at each, has been proved. But whether it can be applied economically on native farms is unknown, though it would almost certainly be a paying proposition in the wetter years when losses from black pod are severe. I understand harvesting is often done by labourers at a fixed price per 1,000 pods. A farmer would hardly pay for diseased pods, and the labourer would have no inducement to cut them off.

Cacao Breeding.

This is much more straight forward than the purely agricultural work. We recognize that Nigerian cacao is *Leiocarpa* with a little bit of poor *Trinitario* here and there (mainly round *Agege*). We also recognize that the original introduction of *Leiocarpa* (made by a native) was a matter of pure luck, and that this species does not necessarily represent the best kind of cacao Nigeria may be able to grow. Indeed there are indications that certain *Trinitario* trees would be far more vigorous growers and would produce far more valuable cacao.

We started off by making selections within the *Leiocarpa* species. Progeny trials have been planted. But breeding never holds out much chance of success if confined to a pure species. We may be able to increase the yield a little and the quality a little, but we can never get very far without importing new blood - or more precisely new genes. Actually our selections are only about 9/10s pure *Leiocarpa*, so there is just a rather remote chance of getting some definite improvement, and, in fact, the progeny of one of the seventeen selections is showing indications of having larger beans.

We examined a number of *Trinitario* trees, resulting from those introductions of 30 years ago, and found them to contain poor beans (though some have very large pods); also most were self -incompatible.

The present programme is, therefore, to import as much material - other than *Leiocarpa* - as possible. We know now what to ask for, and any new introductions should have come from self fertilized seed of trees which

- a) Have been specially selected on yield and bean quality
- b) Have been proved to be self compatible.

This is where Trinidad and the Gold Coast will help us. At the moment we only have about 60 such introductions, and some of these are now coming into bearing. The next stage is to test the best of these, or of future introductions, in progeny trials; luck, or the abstruse workings of genetics, may produce one which will show no signs of incompatibility in its offspring. Provided such offspring are strong growers and have better quality beans the problem is solved. To help on luck a little it will be necessary to try crossing *Trinitario* introductions with the best of our own proved selections.

Strange though it may sound no one - except the Dutch in Java - has attempted scientific breeding work in cacao. Trinidad Department of Agriculture, on the advice of the cacao research scheme laid down a 12 acre progeny trial as recently as 1933. No controlled pollination was adopted to procure the seed for this trial, and it has since been found that the progenies were the result of mixed pollination by unknown, and almost certainly inferior male parents. Before the war (1914) the Dutch tried self pollination preparatory to laying down progeny trials, but they couldn't get any pods to set (self incompatibility in the Trinitario group). Their work was stopped by the war, and the idea of controlled pollination was not put into practice again till 1929 when they started on a small scale to work out the inheritance of bean colour.

We are therefore aiming to produce a type of cacao which will breed reasonably true to a good bean quality, will show no signs of self incompatibility (thus insuring as high or higher yield than our present *Leiocarpa*) and will be more vigorous in growth and better able to withstand adverse conditions. A pretty long distance job, but one which no other country is doing, and not necessarily more difficult than oil palm breeding. The occurrence of sterility in progenies of thin shelled oil palms is an interesting counterpart of the incompatibility found within a large proportion of Trinitario cacao.

For this cacao work we are now asking the Ibadan Native administration to allocate to us 500 acres of the Gambari Native Administration Forest Reserve.

Conclusion.

The object of these somewhat outspoken notes is to try to make people in Nigeria interested in cacao. It took a new comer to Nigeria to put before us the necessity for doing so, and I quote the first paragraph of his memorandum written after only two months in the country.

"A.D.A. to Hon. D.A. October 3rd 1930.

The export of Nigerian cacao has reached an annual figure of about 50,000 tons, Figures from the Produce Inspection branch report an export between October 1929 and June 1930 of 47,360 tons. An export of this magnitude justifies the inauguration of special work on cacao improvement both in planting material and cultural methods particularly if, as Mr. Findlay indicates, the available good cacao land in the South Western Provinces probably has by now, to a great extent, been planted up. In the latter case any considerable increase in cacao exports must come from the improvement of existing holdings rather than an extension of the area under the crop".

In the past nine years we have clarified what the problems really are and have definite ideas on how to tackle them. Perhaps in the next nine years we shall be given the means of actually doing something.

O. J. VOELCKER

SENIOR BOTANIST