DEPARTMENT OF AGRICULTURE.

GOLD COAST.

# REPORT ON A VISIT TO NIGERIA NOVEMBER-DECEMBER, 1945.

by

M. GREENWOOD, SENIOR SPECIALIST.

April, 1946.

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## INTRODUCTION.

I visited Nigeria during November and December, 1945, with instructions to report on such parts of the Department of Agriculture's recent work as would be of interest and instruction to ourselves in framing our plans of research and development. It was hoped that in matters of research we might be able to avoid the duplication of effort which has been an unfortunate feature of past work in the West African Colonies; that in developing internal markets each Colony should be aware of the work done by the other; and that there should be collusion in the production and marketing of any product for which there was a ready place in the world market.

2. A provisional itinerary was prepared by you, and submitted to the Director of Agriculture, Nigeria. This was elaborated by the Deputy Director, Ibadan, and the Assistant Director, Zaria, who made full plans for the edification and the entertainment of my wife and myself. We should like to express our sincere appreciation of the courtesy and patience with which our questions were answered, and of the fund of hospitality offered us by so many members of the Department.

3. I arrived in Nigeria on November 21st and left on December 30th; a detailed itinerary is attached as Appendix I. I had the good fortune to serve in Nigeria between 1927 and 1931, and to have been a representative of the Gold Coast at the Third West African Agricultural Conference held in Nigeria in 1938. At this Conference a very complete account of the work of the Nigerian Department was rendered, and this report is principally concerned with subsequent developments in the programme then outlined.

## WARTIME AGRICULTURE.

4. Whilst it has been possible to continue most of the major investigations then projected, and to institute others, e.g. research into oil-palms, the main work of the Department since 1938 has necessarily been directed to the war effort: to the reduction of imports by increased self-sufficiency in native foodstuffs; to the production of European foods for a white population greatly enlarged by military operations; and to increased exports of commodities vital to war needs.

5. These tasks have sat more lightly on the Nigerian Department than on ourselves. Pre-war imports of food (1932-36) for Nigeria's population of 20,600,000 were of the order of £1,500,000 per annum. The Gold Coast, with a population of 3,800,000, imported over the same period food to the value of £1,200,000 per annum. (These figures include spirits and tobacco whose consumption is roughly proportional to total food imports, e.g. 1932

Nigeria £528,000; Gold Coast £[illegible]. It cannot be claimed that this difference in self-sufficiency has arisen by official dictation of policy. Discounting the established trade in oil-palm products, the major agricultural exports of Nigeria (groundnuts) and the Gold Coast (cocoa) have been established by native enterprise, and have waxed and waned according to the remuneration offered by the merchants. The degree to which export crops have competed with food farming in the West African Colonies has been largely determined by the nature and extent of the agricultural land which has been put into good communication with the ports.

6. The drive for self-sufficiency was, however, much further advanced in 1938 in Nigeria than in the other West African Colonies; a fact to which the Leverhulme Commission drew attention in their Technical Report (page 31). With the Departmental organisation existing at the outbreak of war it was possible to make rapid progress in the development of many essential foodstuffs; particularly outstanding in the case of rice.

7. Very complete investigations into the potentialities of rice production had been begun in 1938, and full advantage of the knowledge acquired was taken in 1940 when, by the issue of tested varieties, production was greatly increased in the established rice-growing areas of Sokoto, Bida, Ilorin and Abeokuta, and the crop was successfully introduced to many parts of the Southern and Eastern Provinces. Production in 1940 was estimated at 40,000 tons, and imports in that year were 2,700 tons compared with 7,300 tons in 1939 and 15,000 tons in 1936. In his Production Report for 1944 the Director of Agriculture says :-

> "Rice-planting has been extended to Oyo and Ondo. In other parts of the Southern Provinces it has acquired its own momentum and requires little propaganda from us".

Requisitions for Military use were about 4.300 tons in 1944, and in 1941 800 tons were exported to the Gambia. Whilst the country would now appear self-supporting it has been decided that the export of rice shall not be fostered until there is clear evidence that the home market is saturated.

8. With its large indigenous cattle population, its varied climate and large agricultural community, Nigeria has been able to supply its European war-time population with enviable quantities of dairy and garden produce (a paradise clouded, in the opinion of some Nigerians, only by the absence of an investigational centre such as the Accra Brewery). The development of some commodities has reached a stage when export is possible, and the import of Nigerian potatoes, onions, possibly dairy-produce, into other West African Colonies

merits /

merits serious consideration in any scheme for their unified development.

9. Some war-time projects in European supply, such as the Northern dairies, piggeries and sugar production, can be readily diverted to improving the standard of health of the African. There are, however, enterprises like the Southern dairies and the Agege Stock Fattening Scheme whose place in the post-war programme cannot be decided without further experiment under normal trade conditions.

10. Nigeria's major export crops, palm-oil, palm-kernels and groundnuts, were, of course, amongst war priorities, and the maintenance of the pre-war volume of exports has involved the Department not only in considerable propaganda but in essays in foodstuffs distribution and price stabilisation to prevent the producers of essential exports being lured from their task by the prospect of greater remuneration in food-farming. How successful these efforts were may be judged by the Produce Inspection figures for 1937-8 and 1941-2.

| Year | Palm Oil tons | Palm Kernels. tons | Groundnuts. tons. |
|---|---|---|---|
| 1937-8 | 129,162 | 282,947 | 207,394 |
| 1941-2 | 147,678 | 344,820 | 239,309 |

11. In company with the other West African Colonies, Nigeria has been called on to produce rubber, castor oil and other vital supplies, and the Department is to be congratulated on the results achieved. Our own Department owes a debt of gratitude to the late Director of Agriculture, Nigeria, Capt. J.R. Mackie, who was the first, amongst the critics of this country's early war efforts, to point out that in Nigeria war production was shouldered by a European staff of 58 (excluding Marketing Officers) all of whom were exempt from combatant service, whereas in the Gold Coast the available European staff was 23, no less than 14 of its abler members being on active service during the more vital years of production.

POST-WAR POLICY.

12. I discussed with the Director of Agriculture the major aspects of our own post-war policy, which are to safeguard such export crops as we now possess, to aim for a greater degree of self-sufficiency in food in respect both of quantity and nutritive quality, and to develop particularly such crops as coconuts, groundnuts and rice which will have potentiality as exports once the acute local demand is satisfied.

13. Mr. Beattie said he was in cordial agreement with this policy, which was that of his predecessor, who in his Annual Report for 1943 says:-

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"The experience of the last year or two tends to confirm that in a country of the size of Nigeria, with its diversity of soil and climate, the best results are obtained by going all out for the maximum production of all crops, and the retention of a proper balance between the crops produced for export and those required for local consumption, rather than by concentrating entirely on one or two export crops.... Our insistence on the need for full experimental proof of the soundness of the advice offered to farmers and the resultant somewhat slow tempo of our extension work have recently been severely criticised. Recent experience in production drives and the comparative failure of more spectacular methods have more than justified this policy".

14. The programme for the agricultural development of Nigeria had not been announced at the time of my visit. A meeting of the Development Committee took place in December, but my request to be allowed to attend was not entertained with the seriousness which I thought it to merit. Its findings will no doubt reach you through more formal channels. The Development Secretary, Mr. F.E.V.Smith, very kindly discussed with me the prospects of resuming the export of bananas from the Gold Coast and the extent to which this trade could be linked with the Cameroons' exports.

15. The Nigerian Department is understaffed, though to a considerably less degree than ourselves, and recent commitments have spread its personnel over a much wider radius than heretofore. Unless the staff can be strengthened, or its communication lines shortened, there appears to be imminent danger of a constant migration of officers from one station to another. I make this observation with affectionate memories of the solidarity of the pre-war Nigerian stations and with experience of the discontent which has been roused both in the Department and in the farming community by the frequent changes in personnel which were a pre-war feature of most Gold Coast stations.

PALM-OIL PRODUCTS.

Palm-oil and palm kernels still rank together as Nigeria's major agricultural export; shipments averaged 140,000 and 350,000 tons per annum respectively between 1934 and 1939. The values of the principal exports were in 1937 :- Palm-oil £2,400,000 : Kernels £3,600,000 : Groundnuts £4,000,000 : Cocoa £3,600,000, and in 1938 :- Palm-oil £979,000 : Kernels £2,191,000 : Groundnuts £1,300,000 : Cocoa £1,500,000.

17. /

17. The Eastern Menace has loomed over the industry since the days of the First West African Conference (1927) when few of the delegates were as sanguine as Mr. P.H. Lamb, who said :- "The problem is whether low grade fruit and inefficient methods of extraction with no overhead charges can exist in competition with high grade fruit and very efficient methods, but with high overhead charges. Personally I believe they can." Mr. Lamb's prophecy, based on the increasing world consumption of vegetable oils, has been fulfilled, and a place in the market has been found both for Sumatran soft oil and, at a considerable price discount, for Nigerian hard oil.

18. Oil from the East arrives on the home market with an F.F.A. content less than 4 per cent, and there has been continuous propaganda in Nigeria to produce soft oils approaching this standard in the hope of securing a higher price. A scheme for subsidising palm-oil factories was prepared in 1927. It received no local support, and headway has been made only through the medium of small screw presses. Manlove and Watson (Second Conference, 1929) considered that the demonstrated superiority of the press over the native soft oil process would ensure its adoption in areas where soft oil was made but, since it entailed extra labour, it was not likely to be popular in hard-oil producing centres unless a very substantial premium for soft oil were offered.

19. An attractive premium has been offered for the first time during the war years, when grading into F.F.A. classes has been undertaken by the merchants. The grades,* prices, and percentages of buyings falling into the various grades between October, 1944 and January, 1945 are given below.

| Grade | I | II | III | IV | V |
|---|---|---|---|---|---|
| F.F.A. per cent | 0 - 9 | 10 - 18 | 19 - 27 | 28 - 36 | >36 |
| Price per ton | £13.14.3 | £12.4.3 | £11.4.3 | £10.9.3 | £9.14.3 |
| Percentage of buyings. | 65.7 | 11.8 | 10.9 | 8.8 | 2.7 |

The figures show how quickly quality looks after itself, once a sufficient reward is offered: a similar experiment with cocoa would no doubt confound some of the critics of the quality of the crop now marketed.

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* The prices should be of interest to any student of inter-colonial trade. In the Gold Coast palm oil corresponding to Nigerian Grade II was during the same period bought for military purposes at £28 per ton, Eastern Province, and £42 per ton, Western Province. The present retail price is 1/3d. per bottle or £90 per ton.

20. It appears by no means certain that the present system of differential grading will be maintained after the war, and an effort to improve quality still further is being made by the importation of power-driven mills. Twelve No.1 Pioneer Mills have been ordered, at a cost of £5,000 each, and the first is now being erected at Okigwi.

21. The Department has for many years been conducting propaganda for the establishment of native-owned plantations of palms. Demonstration plots laid down by the Department have not been uniformly successful. In some cases Calapogonium has been used as a cover crop. After providing a good cover and re-seeding itself for five to six years it has mysteriously failed, and it has been found impossible to re-establish covers or weed growth. Palms are dying rapidly, and the toxic (?) effect of Calapogonium is being heightened by erosion.

Oil Palm Research Station.

22. The urgent need for a West African Station to conduct research on oil palms was first pointed out by the Hill Committee (Kew) in 1919 and has been stressed at all the subsequent West African Conferences. At the 1938 Conference it was for the first time definitely recommended that such a Station should be established in Nigeria. A site of 4,300 acres to the west of Benin City was chosen and opened up in 1939.

23. An account of the early work on the Station has been given by Murray (Tropical Agriculture XXII 5, p. 93 (1945). At the time of my visit funds for its establishment and maintenance had not yet been made available. Its housing and general equipment were rudimentary : it was being run by a staff of two Europeans, and particular tribute is due to them and their predecessors for the amount of good work which has been accomplished 500 acres have been developed for experiment. 100 acres of natural palm grove are under regular observation, and the Station is also collecting yield records from 900 acres of palms in various parts of the Eastern Province. An account of the main experiments follows.

24. Yield Records. Individual tree records are being collected from Block E T (100 acres) which has been left undisturbed with an average density of 12 palms per acre; from 8 African-owned plots east of the Niger, from U.A.C. Plantations and Departmental plots. Peaks of fruit production are at the end and the beginning of the rains, roughly six months after flowering peaks. The greater peak is at the beginning of the rains, about 70 per cent of the crop being harvested in the first 6 months of the year.

25. Establishment Trial (FQ 1). 1940.

5 Treatments : 5 Replicates : Latin Square : Plot Size ½ acre.

The main object is to find whether the estate practice of putting down a green manure cover, a procedure not acceptable to the African farmer, is any more efficient than a bush-cover or intercropping. Treatments are :-

A. )

A. Intercropping : Benin System. Cropped 2 years : fallow 7 - 9 years.

B. Exhaustive Cropping. To be fallowed only when exhausted.

C. Weed cover. Cutlassed to knee height for direct comparison with leguminous cover (E).

D. Weed and bush cover. Establishment amongst regenerated bush. Cutlassed only once annually, at end of rains. In addition to mulch effect this appears to be a good practice, as clearing takes place at the time of maximum sunlight, which oil-palms appear to relish.

E. Standard practice. Leguminous cover. Pueraria javanica (slow growing) established through faster growing Calapogonium.

Treatments A. 1940 yams. 1941 yams. 1942 fallow.

B. 1940, 41, 42 Yams. 1943 Early maize, cassava. 1944-45 cassava - replaced cocoyam October 1945.

Nitrate Content. Highest under leguminous cover (E).

Moisture Content. During dry season highest in D (significance doubtful ?).

Costs. Lowest for D.: A and B not directly comparable : have proved most expensive despite sale of crops.

Growth Rate. Determined by count of number of leaves on two selections planted through area. Results are as yet tentative. Growth rate is so far greatest on cultivated plots A and B, and apparently greater under bush cover D than under leguminous cover E.

26. Burning V. Non-burning. (FQ 2). 1940.

2. Treatments : 7 Replicates: Randomized : Plot Size ½ acre. Determination of nitrate content, made by the Agricultural Chemist during 1944 and 1945 showed that nitrification was, despite very large plot-to-plot variation, consistently (and probably significantly) higher on the non-burnt plots.

(Maximum values (March 1945) Non-burnt 22. Burnt 16
Minimum values (Oct. 1944) Non-burnt 4. Burnt 3
parts per million nitric nitrogen.)

27. Soil Covers (FQ 3). 1943.

9 Treatments : 9 replicates : Plots 1/20th acre. Nine covers (i) Calapogonium (ii) Tephrosia candida (iii) Centrosema pubescens (iv) Centrosema plumieri (v) Pueraria javanica (vi) Weeds knee height (vii) Weeds untreated (viii) Elephant grass (ix) Acioa Barteri.

Soil Covers /

Soil Covers (FQ 3N). 1944.

5 Treatments : 9 replicates.
(i) Wild canna (bidentata) (ii) Pueraria (iii) Acioa Barteri (iv) Clean weeding (v) Cassia alata.

28. Seed Testing. (FP). 1941.

Selected seed is planted out for comparison with mixed seed from wild trees. Three methods of planting are being tried (a) 3' x 3' x 3' planting holes (b) ditto with heavy mulch in dry season (c) planting hole 3' square, 5' deep. Lower 2' feet of earth not replaced in hole, so that planting level is 2' below surface. This practice has been found (Sampson) successful with coconuts in Ceylon in preventing subsequent baring of roots.

29. Spacing Trials. Various Blocks. 120 acres. 1942.
8 Spacings : 12 replicates, Densities vary from 22 to 114 per acre.

Triangular (i) 21' (ii) 25' (iii) 30' (iv) 42'

Square (v) 12' x 65' (vi) 21' x 65' (vii) 30' x 65' (viii) 21' x 40'.

Three covers (a) Elephant grass (b) Bush (c) Pueraria, are established. An estimate of the number of cattle that can be grazed on the covers is being made. Ultimately the area will be grazed and intercropped, using ploughs, between rows.

Covers were planted in 1942 : palms were planted in 1943, but wholesale replanting has been needed during 1945. The reasons for such heavy failure are not fully known. Losses from bush-rats have been high, and every plant must be protected by a wire screen. Attempts to screen off plots or portions of plots by stake hedges were not successful.

30. Pollination. The method of Hill and Mason (1925) modified by Smith (1929) has been further improved. Two days before they are judged about to open male and female flowers are bagged after sterilisation with 4 per cent formalin. Stout canvas bags with a celluloid observation window (or during war-time with a retractable corner) are used. The stem is trimmed and the bag tied with its mouth fitting around a cotton-wool collar. Male flowers, when fully open, are cut off below the bag and carried to the laboratory, where the pollen is sifted and stored in small tubes (selection) or Petri dishes (mass pollination) kept in a desiccator. Female flowers are pollinated one day before they appear receptive, and on the two succeeding days. Pollen is blown by an insufflator through a hole in the celluloid window, which is then resealed by a plaster patch. Bags are left in position until all the stigmas are withered (one to three weeks).

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31. Breeding Programme.

A. Improved Seed for Farmers. Three types are being produced from mixed pollen from selected trees :-

(a) Thick-shelled x. Thick shelled. Primarily for kernel market, but parents selected for a high percentage of mesocarp.

(b) Thick-shelled x Thin-shelled. A good all-round type, consisting of equal numbers of thick and thin shelled.

(c) Thick-shelled x. Pisifera. Produces thin-shelled type (Congo 100% ?) (Pisifera selfed = abortive. Thin-shelled selfed = 25 per cent pisifera).

B. Uniform Seed for Experiments (Cultivations, etc.) Self-pollinated thick shelled from selected trees.

C. Studies in Inheritance, etc. Temporarily abandoned. The Ju-ju palm (var. idolatrica) with the inherited character of fused leaflets has promising uses in determining the spread of pollen (cf. axil-spot in cacao).

32. Germination. The problems of germination, so confounding that many of the older generation of farmers still believe that the oil palm can be generated only by act of God, are far from solved. Auchinleck and Waters (1927) reported that by soaking in warm water for a period of 7 days a germination of 80 per cent in two to three months was obtained in Sumatra, in contrast to the old rate of 60 per cent in 12 to 14 months : Barnes hoped to improve this performance by evacuating the seed before wetting. The present system in use at Benin has given an average germination of only 50 per cent in 6 to 9 months. The problem seems to call for an investigation of the biochemical changes taking place during germination, and would appear sufficiently important to warrant the assistance of the Empire Products Research Council.

The method in use at O.P.R.S. is as follows :-

Seeds are packed in charcoal in trays, 8" x 13", which hold 600 thin-shelled or 400 thin-shelled seeds. The trays are stacked in a series of ovens kept at 35 ± 3°C by a wood fire. After six weeks each tray is examined fortnightly, and seeds in which the plumule is apparent are transferred to boxes from which they are removed to the nursery in the early rains : they remain in the nursery about 15 months before being planted out in the field. Germinations are started in mid-July so that the majority of the seeds shall remain in the trays during the dry season. The seed boxes are raised from the ground to keep out ants. Various

trials /

trials with sterilized and non-sterilized earths of different textures plus artificial and organic manures are in progress.

33. Diseases.

(a) Basal Rot. A root disease, not yet identified, which causes the loss of 50 per cent of nursery seedlings during the dry season.

(b) Yellowing (Bronzing) Disease. Widespread : very prevalent at Nkwele. Yield falls, trees look sickly and eventually die. Nitrogen and phosphate treatments proved ineffective. Wood-ashes, at 90 lb. per tree, brought recovery within 12 months. Leaf analyses made for Messrs. U.A.C. suggested that plants suffered from potassium deficiency. Application of 30 lbs. sulphate of potash per tree has caused two trees to recover in 12 months.

(c) Lemon Frond. A bright yellow leaf discoloration apparently caused by swampy conditions.

(d) Patch yellowing. Probably a fungoid disease which produces on the leaves yellow patches which drop out, leaving a vein net-work.

C O C O A.

34. Trinidad importations and progeny from selected Nigerian seed are being tested, in conjunction with spacing trials, at the Departmental cocoa farms at I.N.A. (Ibadan) and Owena (Ondo). The necessity for preserving these strains, selected from 1931 onwards, was enhanced when the discovery of Swollen Shoot disease made the Scheme (1938) for their multiplication at Tafo for re-issue to Nigeria temporarily infeasible.

35. Difficulty in establishing cocoa has been experienced at both Stations : unsuitable soil conditions have added to the havoc wrought by capsids. At Owena, established in 1933 on the crest of a hill, replacements are still needed on account of the closeness of parent rock to the surface, which has involved considerable juggling with the original planting holes. At I.N.A., on the other hand, failure has been ascribed to planting on a slope with a cover of transported sandy soil so deep that the moisture requirements of cocoa cannot be satisfied. This finding has been apparently justified by success in planting on a second area at the summit of the slope, where roots can more quickly reach the clay horizon overlying parent rock. There are, however, some hearty survivors in the original area, and other factors in establishment may also have been involved. Some recent supplies were suffering from very acute iron chlorosis.

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36. At Owena selection T38, a very robust performer in the First Progeny Trial at Tafo, has shown the greatest promise; it is being multiplied at I.N.A. for issue during the re-planting of areas cleared of Swollen Shoot disease. Spacing trials from 8' x 8' to 15' x 15' have so far pointed to the advantage of close planting.

37. In 1945 an Entomologist from the West African Cacao Research Institute was attached to Owena to study capsid problems. Counts of D. theobroma and S. singularis are made on five days of the week by collectors working a circle of 3 miles radius. Collections are also made daily on the Station cocoa. A sharp rise in the relative percentage of D. theobroma in the latter collections led to the discovery that Distantiella was feeding on citrus, which thus provided a reservoir for re-infestation of the picked cocoa. Work on the host plants of both capsids is in progress in the field and on potted plants. Interesting records of parasitism and hyperparasitism are being obtained from dissections, made twice weekly, of collections of Sahlbergella in three growth-stages, and of the extracted Euphorus larvae. Breeding trials and life-history studies of the parasite Euphorus sahlbergellae and the hyperparasite Mesochorus melanothorax are being made.

38. Swollen Shoot disease. Within a few months of the completion of the West African Cacao Research Institute training course for Nigerian surveyors, Swollen Shoot disease was discovered in November, 1944, at Egbeda, 13 miles east of Ibadan. This outbreak is the largest yet disclosed and covers a triangle (Egbeda-Badeku-Gbedun) with sides 2 miles long. A small infected area, Iware-Olanla, was discovered north of Egbeda in January 1945, whilst a third small area was found at Oda-Ona, south of Ibadan, in September 1945. At the end of November, 1945 infection had been found in 272 farms covering 317 acres; the affected tree population was estimated at 150,000. The disease had not been discovered outside Oyo Province.

39. I visited the outbreaks at Oda-Ona where infection was light and the health of the trees not yet seriously impaired, and at Fashade-Badeku. Here there has been progressive dieback since the outbreak was discovered. One farm (12/IV/14), planted in 1922, had obviously been affected for many years. There were few surviving trees and from the poor quality of secondary growth it appeared unlikely that cocoa could be successfully re-established. There was a multiplicity of mosaic patterns, including vein-clearing and frosting, pin-pricks and patch-clearing; one farm (12/IV/24) containing no dead trees had a number of leaves which showed mosaic in one half only. No rounded pods were seen, but dwarfed and mottled pods were common. Swellings were mainly confined to twigs.

40. At the time of my visit the Cocoa Survey Officer was visiting the Gold Coast to discuss measures for dealing with the disease. Although only one-third of Oyo Province had then been surveyed it was thought unlikely that any major occurrences remained to be discovered. There was strong temptation to offer compensation in respect of the relatively small number of trees affected, so

that their clearance could be expedited. It was realised, however, that such a procedure might have unfortunate repercussions in the Gold Coast, where it would be impossible to offer like compensation for the millions of affected trees. Arrangements had been made for a Political Officer from Oyo Province to visit the Gold Coast to discuss the co-ordination of policy and propaganda, and for a member of the West African Cacao Research Institute staff to demonstrate in Nigeria the method of cutting-out adopted in the Gold Coast.

41. I joined the Swollen Shoot hunt by examining the more obvious areas of dieback along the roadside. My only finds were two large patches of sickle-leaf, one 7 miles south-east of Ife on the Ondo road, the other 8 miles south-west of Ife on the Oyo Farm road. In both cases sickle leaf was associated with acute iron chlorosis.

## SOIL FERTILITY.

### SETTLED FARMING.

42. The farming systems which Faulkner introduced to Nigeria in 1922, in an attempt to establish a settled type of agriculture, are sufficiently well known to call for only brief summary. Supported by many years of controlled experimentation they rank as classics in tropical agriculture.

43. In the Northern Provinces the value of manure, supplied by nomad Fulani Cattle, was well understood. Peasant farmers were induced to keep their own cattle, to use them for ploughing, and to feed and bed them so that they produced a quantity of farmyard manure adequate for the extended acreage which ploughing brought into cultivation. The scheme, which involved the Department in the buying and training of cattle, and in the provision of credit for the purchase of cattle and ploughs (later taken over by the Native Administrations) made rapid progress, particularly when an iron plough was substituted for a wooden plough of local construction. It inspired our own work in the Northern Territories (see Lynn. Bulletin No.33 (1937) ). During the war years the lot of the Nigerian mixed farmer has been a happy one.

44. It cannot however, be claimed that the problems of the Northern Provinces are solved. As population increases so must the unit-holding per family decrease in size. A system which works well on a farm of 15 acres cannot be expected to function on a farm of 4 acres, the accepted modal size in the Kano area. Much remains to be done in soil-conservation and in the utilisation of waste matter.

45. For the South, where trypanosomiasis forbade the keeping of cattle, the digging-in of green manures was recommended. An early set-back was encountered in parts of the Eastern Provinces where great difficulty in establishing leguminous covers was experienced. Greater success, particularly with *Mucuna utilis*, was obtained in Oyo Province, but for various reasons, some of which are discussed below, the system has not been adopted by the African farmer. Interplanting of cowpeas is, however, an established native practice, and in his Annual Report for 1938 the Director of Agriculture says :-

"There

"There seems little doubt that farmers (Oshogbo) are making more use of cow-peas to prevent soil wash and are thus attempting a modified form of green-manuring which they are working out for themselves".

46. A very valuable appraisement of the Department's work on soil fertility has been presented in the Technical Report of the Leverhulme Commission. The authors (Mr. H.C. Sampson and Dr. E.M. Crowther) regret that in Nigeria there appears to have been no pre-experimental survey of local agricultural systems comparable to that carried out in North Mamprusi (Lynn. Bulletin 34 (1937)). It would appear most desirable that to assess the value of an 'improved' method the local method should be watched, not only through all the courses of its rotation but through various shifts of ground. There have been a number of cultural and manurial treatments which have given increments of the order of 100% on poor land but in which the final yield has been below that of the farmer next door.

47. The obtaining of accurate information from the farmer is not easy until his confidence has been gained by prolonged personal contact. But the difficulties appear to have been exaggerated by Hill and Waters (1927) who say:- "for definite information we have been compelled to employ a system of espionage and even then we have had to avoid any suggestion that we would like to weigh the produce which the farmers reap".

MIXED FARMING.

48. War conditions have retarded the progress of mixed farming in the Northern Provinces by reason of the increased price of ploughs and cattle and by the diversion to other duties of officers normally responsible for the supervision of the farms. The number of mixed farmers remained fairly constant at about 2,000 during the early war years and is now estimated at 2,400. The increased demand for meat has given the established farmers handsome returns for their fattened bulls, and a large number have been able to pay off their advances and set up a credit balance.

49. Some disappointment has been expressed that the early phenomenal increase in the number of mixed farmers has not been maintained. Even with adequate staff the number of new farmers is not likely to exceed 250 per annum in the next 5 years; although it is hoped that it will rise to 500 per annum in 1950-55.

50. Two factors limit the rate of expansion. The first is the selection of animals of the correct working type and of the best size for fattening ($5\frac{1}{2}$ - 6 cwt.). This has been easier in war-time, owing to the large choice offered at the central Army buying pool at Daudawa, than it will be in peace-time, for the dealer's practice is to sell all his stock or none. The setting up of 250 farmers per annum calls for 500 trained bulls; another 1,500 are needed annually to replace losses, due to mortality (10%), senescence and sales, in the existing trained stock of 5,000. More rapid progress

could /

could be expected if farmers would train their own bulls; a substantial increase in the Department's training charge on each issue of stock subsequent to the first might lead experienced farmers to do their own training.

51. Disease, particularly acute pleuro-pneumonia, is the second obstacle to progress, and past experience has shown that the bigger the cattle pool the greater is the mortality rate. A course of triple P.P. vaccine (paragraph121) lasts 12 weeks, and it is unlikely that nomadic cattle can be detained for this period. The onus of treatment therefore falls on the Department.

UNIT FARMS (NORTH).

52. The economics of various types of mixed farming relative to hand farming are studied on unit farms from which all details of the farmer's income and expenditure are collected. Incomes on mixed farms range from about £15 to £30 (where bullocks are sold during the year) : the lower income leaves the farmer with a margin of one or two pounds after deducting the cost of clothing and feeding his family and keeping his buildings in repair. I saw 3 types of mixed farm:-

53. (1) Daudawa (Obligatory Cash-crop: Cotton).

Daudawa serves as a multiplication farm for cotton seed. 64 mixed farmers are settled on plots of 15 acres, of which 8 acres are under cotton. The remaining 7 acres are under food crops, of which 5 acres are usually guinea corn, the intention being that each farm shall produce corn for its own use and that of another family. (The consumption of corn is 1½ lbs. per day per adult nutritive unit : the average number of persons per family 4.4 (including children) = 3.5 units : requirement for 2 families = 3,000 lbs. or 600 lbs. per acre).

54. Each farmer owns a pair of bullocks. Extra stock , amounting during the war years to an average of 2 per farm, are kept for fattening. Cattle are fed on groundnut haulms, bush hay, sweet potatoes, etc. : no corn is fed. Cotton-seed is available at 25/- per ton but is rarely bought by the farmers. It has been found that the fuzz on local seed does not produce balling in cattle.

55. The farms have been highly successful. Of the early settlers 46 out of 49 had paid off advances for house, stock and implements by the end of 1943 and had then a credit balance of £350. Mud houses costing £8 pre-war (labour 6d. per day) were originally supplied. Annual repairs to walls and roof cost 15/- pre-war. At the present price of labour (8½d) annual repairs to house and the rebuilding of the compound fence probably cost £2. A permanent stone house with corrugated iron roof is now being built at a cost of £53. The added expense of the permanent type will be partly offset by the chance of lucrative dry-season (fadama) farming during the period now spent in collecting grass and mud. Experiments with a cheaper stone house fitted with a grass roof, and with live compound hedges, are being made in the new N.A. Settlement (35 farms) at Daudawa.

56. /

56 (ii) Maigana (Optional Cash Crop).

In the Maigana farms the farmer grows foodstuffs and fodders in rotation; cash crops are of his own choice. Tobacco is at the moment the most paying crop. Yields (Virginia hybrid) are 500 lbs. per acre, at 6d. per lb. for Grade I leaf. 530 acres were under tobacco in the Maigana area in 1945.

57 As at Daudawa the size of farm is about 15 acres. Optimum stock, to give 15 tons of farmyard manure per annum, is 2 trained bulls, 1 cow, 3 offspring = 5 adults at 3 tons farmyard manure each. A typical farm of 16 acres was cropped in 1945 as follows :- 2 acres groundnuts : 2 acres Miscellaneous (Tobacco, Groundnuts, Sweet Potato, Cassava) : 2 acres Cotton : 2 acres Guinea corn : 2 acres Gero and Guinea corn : 6 acres Kiyasuwa (P.pedicellatum) and Pigeon pea.

58. (iii) Kano.

Five Unit Farms were started at Kano in 1939. In the Kano close farming area no land is available for expansion, and the small size of the holdings makes ploughing uneconomic. Stock were kept on four hand-worked farms of 3 to 5 acres with the object of providing milk, meat and manure; each farm was stocked with one milk cow and a varying number of goats. Donkey cultivation was tried on a larger farm of 6 acres with the expectation that the owner of the donkeys (3) could make extra income by haulage in the dry season.

59. The main object of the experiments was to decide (i) what head of stock could be stall-fed on the produce of a farm of this size, (ii) whether cattle and goats would thrive and breed normally in confinement with no grazing or exercise (iii) what size of holding would prove economic.

60. Goats, consisting of 1 male and from 7 to 11 females per farm, were first kept on raised slatted floors in houses fitted with sun-parlours. Milk yields were very poor : deaths, due mainly to worms and pimply-gut (Oesophagostomiasis) exceeded births. Some reduction in mortality was obtained in 1942-3 by changing to a mud floor and sweeping out manure daily, but goats were abandoned as a failure in 1944 and replaced by one fattening bullock per farm. Donkeys were also abandoned after 2 deaths and the discovery that the farmer was too busy in the dry season to hire the animals out.

61. The farms, which carry various rotations giving about 1½ acres guinea corn, 1 acre groundnuts, ½ acre millet, ½ acre cassava, ½ acre sweet potatoes, and interplants of pigeon peas and cowpeas, have proved capable of supporting man, wife, one child and one animal. Incomes in 1944-45 ranged from £17.11. 0d. to £22. 7. 8d., giving a minimum profit of £2 after deducting family expenses and cost of buildings. The main source of income was the sale of milk at 3d. per bottle.

62. /

UNIT FARMS (SOUTH).

62. A series of eight Unit Farms was started at Moor Plantation, Ibadan, in 1944-45. Each is managed by a peasant farmer and his family, for whom houses have been erected in the farms. Their object is to investigate the economics of a self-contained farm using a green-manure rotation and keeping livestock for sale and manure. The main differences from our Unit Food Farms are the inclusion of a perennial cash crop, and management by a settler rather than by paid labour.

63. Unit Food Farms were laid down in the Gold Coast in 1938. There were originally 14 farms, each of 4 acres, distributed through the Eastern, Central and Western Provinces and Ashanti. They were mainly experimental, their object being to determine whether fertility could be maintained by the use of a green-manure rotation, with and without the help of small livestock, and what annual yield of food crops could be expected from a 4-acre farm.

64. In some farms a four or five course green-manure rotation was practised; in others four years of rotational cropping were followed by two years of sheep folded on a cover of centrosema. A typical farm of the latter type consisted of eight ½-acre plots, of which one was the paddock containing shepherd's cottage, dipping-tank, sheep-shelter, poultry houses and citrus trees; one was pasture alternating with plantains over a 3-year period; the remaining six plots were cropped in the following order :- (i) Yam-beans (ii) Maize - Cowpeas (iii) Cassava (iv) Groundnuts - Sweet Potato (v) and (vi) Centrosema and sheep.

65. The farms have served as distributing centres for improved types of cassava, beans, fowls, etc., and in some cases the growing of demonstration cash crops e.g. tobacco, has disturbed the original project, which was to grow only food crops. In the Central Province, where sheep-folding has been practised, there has been little deviation from the original plan. Two of the three farms survive at Mankessim and Achiasi (Asuansi diverted to war production 1943) and have been sufficiently successful to induce the State of Assin Atandasu to open a farm of its own at Fanti Nyankumasi.

66. Expenditure in the Central Province farms has ranged between £15 and £30 per annum, and has usually been roughly balanced by receipts. The Fanti Nyankumasi farm made a profit of £12 in 1942-43. Sheep and poultry have had their ups and downs. A flock of 20 to 40 sheep has been kept, with annual sales of about 12, and the average head of adult fowls has been about 40.

67. There has been no apparent falling off in yield, early maize being maintained at about 2,000 lb. grain per acre, yams (3 varieties) at 4 to 8 tons, cassava (4 resistant varieties) at 7 to 12 tons. Sheep are, however, permitted some grazing outside the farms, so that the fertility cycle is not a closed one.

68. /

68. A proposal to start Unit Farms in which a settler and his family would grow both food and cash crops and receive financial assistance during their establishment was made in 1941. It was considered (Mr. Waters) that a Unit Farm should consist of (i) Arable land for the production of both food and cash crops (ii) A plantation crop, including fruit trees (iii) Livestock for cash and manure (iv) House and garden (v) A piece of secondary bush corresponding in size to the arable land. It was realized that provision of a piece of bush might be difficult in some places, but it was considered desirable, as lengthening the cropping period seemed a more practical goal than permanent cultivation : the bush would provide both browsing and firewood.

69. Owing to shortage of staff these proposals were not implemented. They are all embodied in the Nigerian system except the piece of bush, which is replaced by a firewood plantation of 1½ acres per farm. Five farms are stocked with sheep and poultry, one with pigs, one with working and fattening cattle, one (coconuts) with both sheep and fattening cattle. With the exception of the last two, which are respectively 13½ and 8¾ acres, the farms are 7½ acres each.

70. The basic sheep farm (Nos. II and III) contains 1 ram, 12 ewes and 25 head of poultry, and is divided into 2 acres arable land : 3 acres permanent crops (fruit trees plus cocoa, rubber or oil palms) 1 acre grazing : 1½ acres fuel plantation. Variants in stocking are :- 4 rams, 48 ewes, no poultry (No. VII) : 1 ram, 24 ewes, 12 poultry (No. V) : 1 ram, 12 ewes, 60 poultry (No. IV). The last type of farm is meant for use near towns, and market vegetables are included in a rotation of four ½-acre plots :- (i) poultry (ii) vegetables (iii) Guinea corn and/or maize (iv) Mucuna late maize. Other variants include (a) the use of green manure v. sheep compost on the arable land; sheep compost v. no manure on the permanent crops (b) increasing the fruit-grazing area at the expense of arable land, the farmer buying stockfeed outside his farm.

71. The pig farm is stocked with 1 boar and 2 sows. Six offspring are kept for fattening, the remainder being sold as weaners. The farm is divided into 1 acre arable (for farmer) : 3 acres arable (for pigs) : 1½ acres fruit : 1½ acres fuel : ½ acre paddock. One of the main problems is to determine whether such a farm can be self-supporting in protein.

72. The cattle farm consists of 4 acres arable : 1 acre cocoa : 2 acres fruit trees : 3 acres grass for grazing : 2 acres grass for cutting : 1½ acres fuel; and is stocked with 3 cows and 2 work bulls, offspring being sold. The arable land is worked on two green-manure rotations A (i) Yams, cotton, cowpeas (ii) early maize - mucuna (iii) sweet potatoes (iv) mucuna - guinea corn : B (i) yams, cotton, cowpeas, (ii) groundnuts - cassava (iii) cassava (iv) mucuna - late maize.

73. 3 fattening cattle, 1 ram, 6 ewes and 12 hens are kept on 4¾ acres of established coconut-grazing to which been added 1¼ acres planted grass, 1¼ acres arable land and 1½ acres fuel. Two of the cattle are allowed to graze : the third is stall-fed with grass.

74. /

74. The farms are, of course, experimental, and many problems will need to be solved. Is it, for instance, possible to establish an isolated acre of cocoa without the provision of more lateral protection than can be supplied in farms of this size ? First plantings of cocoa were far from successful. And if these farms succeed will they give an estimate of the likely success of the system in the hands of farmers denied the close supervision, particularly in matters of animal health, which appears to be given at Moor Plantation ? The experiments will be watched with the very greatest interest.

75. Three of the farms were first cropped in 1944; the others were started only in 1945. There will necessarily be a long interval before the other permanent crops are sufficiently established to bring in incomes comparable with that of the coconut farmer. More immediate data could be expected if an established plantation of mixed economic trees could be carved into units, as suggested by the Rev. H.M. Grace in the Achimota Agricultural Extension Scheme for Bunsu in 1936. Such a scheme would, however, give little information regarding the establishment of orchard crops, particularly of fruit trees, which it is desired to further.

76. I feel strongly that wherever possible an area of secondary bush should be included in the units. If fertility cannot be maintained by the present system of manuring or rotations (including the possible turning up of the established pastures) it would then be possible to start a new system, embodying the findings of the first experiments, and taking advantage of the laborious establishment of the permanent crops, which would otherwise need to be abandoned. The exhausted arable plots would prove valuable sites for carrying out experiments in regeneration of fertility.

GREEN MANURING.

77. The four-course green-manure rotation first tried (1922) at Moor Plantation was as follows:-

I Yams (November); Mucuna (July).

II Mucuna (Self-sown and supplied); Ridged June; Cotton (July).

III Groundnuts (March); Mucuna (August).

IV Ridged March; Early Maize (April); Mucuna (June); Ridged October for Yams (I).

Ridging includes digging-in of Mucuna.

78. The rotation was continued till 1933. There was no very marked decline in yield except in the case of cotton. Compared with average yields over the whole plantation the following reductions in yield were observed :- Groundnuts ± 0%, Maize - 10%, Yams - 17%, Cotton - 63%. The failure of cotton is of interest. Hardy has recently suggested (Tropical Agriculture XXII.7, page 119 (1945)) that a low carbon/nitrogen ratio may promote vegetative growth at the expense of bolling.

It /

It is possible that the continued digging-in of green-manure may have produced an excess of available nitrogen in these plots.

79. The system was not taken up by the local farmer. Since mucuna is not edible (mucuna meal has given poor results as a cattle feed) the rotation produces only four payable crops per annum. It might appear to have no advantage over a four-year period of intensive cropping followed by a four-year bush fallow; data to contest this point were not available. Its chief drawback was the amount of labour entailed in three ridgings in four years. Minor objections were that groundnuts were rarely grown by the local farmer, and that cotton was never grown as a sole crop.

80. In a revised rotation, worked between 1934 and 1937, Mucuna was largely replaced by Popondo (Phaseolus lunatus = Apatram) and cropping was intensified to give seven payable crops per annum.

I Yams (February)*; Popondo (June); Burnt and moulded February.

II Early Maize (April) with Cotton (July); Burnt February.

III Early Maize (April); Mucuna (July); ridged August; Late Maize interplanted with Popondo (September); moulded February.

IV Early Maize (April) with Popondo (June); Burnt and ridged January.

81. Under this rotation there was a rapid fall in yield. Yields of early maize which had been between 1,000 and 1,900 lbs. per acre in the old rotation ( paragraph 77) dropped from 974 lbs. in 1934 to 805 lbs. in 1937. The cash value of the total crops was no greater, whilst labour costs for the new rotation were £2 per annum higher than for the old (4 acres at 1/- per day). Popondo provided a poor cover, it proved not so popular an article of diet as was expected, and yields were so low (80 lbs. shelled beans per acre) as to be barely worth picking. Compared with local practice the rotation offered a poor selection of crops.

82. Four new rotations were begun in 1938. Popondo was entirely ousted in favour of Mucuna, which was used as an interplant rather than as a sole crop. Cassava was introduced for the first time whilst melons, okras, cowpeas and tobacco were included as interplants in one or other of the rotations. Two examples are given.

B./

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* Late planting of yams adopted to enable the detection of eel-worm damage during storage.

B. I Yams (February) i.w. Mucuna (July)

II Groundnuts (March) f.b. Late Maize i.w. Mucuna (September).

III Early Maize (April) i.w. Cassava (July) i.w. Cowpeas (September).

IV Cassava (contd.) f.b. Mucuna (July) f.b. Tobacco (September).

C. I Yams (February) i.w. Early Maize (April); Mucuna (July).

II Early Maize (April) i.w. Melon f.b. Late Maize i.w. Mucuna (September).

III Yams (February) i.w. Okra (March); Mucuna (July).

IV Groundnuts (March) f.b. Late Maize i.w. Mucuna (September).

83. This rotation was being closed down at the time of my visit. Mucuna as an interplant has not been successful and has smothered both yams and early maize. Due provision for the type of mixed cropping represented in this rotation has been made in the Unit Farms (paragraph 62). A new series of four green-manure rotations, relying on cowpeas as an interplant and once more using mucuna as a sole crop, to be dug-in, was under preparation. The suggested scheme was :-

| | I | II | III | IV |
|---|---|---|---|---|
| P | *R. Early Maize | Mucuna | R. Yams | Cassava (contd.) |
| | Cotton | R. Late Maize | Cassava | Mucuna |
| | Cowpeas | | Cowpeas | |
| Q | R. Yams | R. Early Maize | R. Early Maize | Cassava (contd.) |
| | Cotton | Mucuna | Cassava | Mucuna |
| | Cowpeas | | Cowpeas | |
| R | R. Early Maize | R. Early Maize | R. Yams | Cassava (contd.) |
| | Cotton | Mucuna | Cassava | Mucuna |
| | Cowpeas | | Cowpeas | |
| S | R. Early Maize | R. Groundnuts | R. Yams | Cassava (contd.) |
| | Cotton | M. Tobacco | Cassava | Mucuna |
| | Cowpeas | | Cowpeas | |

*R = Ridged.

The /

The main comparisons in this series are: P v. Q the relative effects of yams and early maize on interplanted cotton; P v.R v.S the effect on yams of the previous crops (i) Mucuna - late maize, (ii) early maize - Mucuna, (iii) groundnuts tobacco (Mucuna thought to make yams liable to disease).

84. When green-manuring was first introduced it was thought that lack of available nitrogen might be the factor limiting growth. Little confirmation of this belief was obtained in a number of trials with nitrogenous manures, many of which were carried out under conditions (e.g. after digging-in Mucuna or after a Tephrosia fallow) where a great response could not be expected. That mineral matter, rather than nitrogen, was the immediate deficiency was suggested by an experiment, begun in 1932, in which mucuna was either dug-in green or burned: in the early years burning gave significantly higher crop yields.

85. These results were discussed at some length at the 1938 Conference. It was suggested that if the nitrogen status of some heavy yielding plots (School Farm) were any index, nitrogenous manuring would prove effective once the mineral deficit had been corrected. In 1939 the 'dug-in' plots were accidentally burnt: presumably on account of their higher nitrogen status they gave a much higher yield than the previously burnt plots. From 1941 onwards the original performances have been reversed and significantly higher yields (increment of 153 lbs. over 1,424 lbs.) have been obtained from the dug-in plots.

86. Striking evidence that the modified rotations (paragraph 82) were failing to keep available nitrogen at an effective level was obtained in 1944 by superimposing a small NPK trial (N = 2 cwt. sulphate of ammonia, P = 4 cwt. basic slag, K = 1 cwt. sulphate of potash). With early maize, sulphate of ammonia gave an increase of 52% over a non-manured yield of 940 lbs. dry grain per acre. Phosphate and potash gave no significant increase whether alone or in combination with nitrogen. These results suggest that in the Moor Plantation soils, derived from crystalline rocks mineral requirements can be largely met by a system of green-manuring which provides adequate available nitrogen.

87. It is hoped that information regarding the optimum balance between minerals and nitrogen will be gained from a series of manurial trials which it is proposed to superimpose on the new rotations P and S (paragraph 83).

P : Artificials.

O = nil; N = 3 cwt. sulphate ammonia.

P = 2 cwt. super; PK = 2 cwt. super, 1 cwt. muriate potash; NP : NPK.

To be applied to Courses I and III.

S /

S : Farmyard Manure v Artificials.

0 = nil; 8 tons farmyard manure; ~~Minerals~~ (NPK) equivalent to 8 tons farmyard manure.

4 tons farmyward manure + minerals equivalent to 4 tons farmyard manure.

To be applied only to early maize of Course II.

The idea of following the trend of a rotation by means of an imposed trial of such a size that the over-all yield is not interfered with is an excellent one, and one which we should be well advised to incorporate in our own rotations.

MANURES

Artificial Fertilisers.

88. Attention has from time to time been directed to the impoverishment of tropical soils and the parallel enrichment of British soils resultant from the export of oil-seeds whose protein and mineral matter are the mainstay of intensive British farming. The Leverhulme Commission reminded us (p.13) that before the war the British farmer bought in the form of imported feeding stuffs more nitrogen than as fertilizers and as much phosphate and potash as in superphosphate and potassic fertilizers.

89. There have been occasional demands that this one way traffic shall cease. At the 1927 Conference Paterson stated a case for cocoa; he assessed the fertiliser equivalent of the 1926 export from the Gold Coast (225,000 tons) as 10,227 tons of sulphate of ammonia, 4,252 tons of sulphate of potash and 13,973 tons of high-grade superphosphate. Similar figures could be presented to show the drain on Nigerian soils caused by the export of groundnuts and palm kernels. The position in regard to palm-kernels is particularly serious since the major export comes from sandy soils (Benin Series) with such low fertility reserves that they yield economic crops only after a long period of bush fallow (paragraph 25 ).

90. It is obvious that the inherent fertility of a given piece of land cannot be maintained without the full return of the mineral content of the crops produced: even then some loss due to erosion must be faced. Farmyard manure and composts make only partial return; their continuous success depends on the contribution made by concentrates and fodders grown outside the manured area. Some degree of lateral exploitation of land is involved in the provision of pastures additional to the cropped land. And in these pastures, bush-fallows or leguminous covers, there is vertical exploitation, since their efficiency depends on the speed with which they can enrich the top-soil at the expense of the sub-soil. This exploitation becomes quickly apparent where a great depth of leached sub-soil separates surface soil and parent rock. Where land economy is vital it is imperative to return to the soil as much as possible of the minerals of crops, whether they are exported or consumed locally.

91. /

91. With oil-seeds there are two courses. The first is to express the seeds locally and to use the press-cake to supply the protein and mineral requirements of people and stock. Treatment of the entire tonnage of oil-seeds now exported is clearly not practicable under present conditions, but small-scale expression might well be encouraged to supply coconut, groundnut and palm kernel oils for local consumption and processing, and press-cakes for cattle food (paragraph 226).

92. The second course is to insist on the return to us of artificial manures equivalent to our exports of mineral matter. Where artificials have been found most effective it should, in my opinion, soon be the duty of the Departments to lay down demonstration plots and supervise the issue of manures to farmers, giving financial assistance as in the case of mixed farming. If the success of the gentlemen who have from time to time peddled inert powders as a panacea for the ills of cocoa is any criterion it is likely that the application of artificials at the time of planting would be readily adopted by the farmer.

93. A large number of experiments with artificial manures have been carried out on different soil types in Nigeria. In the North (Samaru and Kano) artificials equivalent to the mineral content of farmyard manure have given comparable results; superphosphate alone has been highly effective. Over crystalline rocks in the South there has been some response to superphosphate applied at the time of planting grain, to plant-ash where the nitrate content is high, and to ammonium sulphate where the nitrogen status is low (paragraph 86). On the sandy soils of the Eastern Provinces marked response to individual and mixed fertilizers has been obtained at Nkwele e.g. Early Maize 1939. No Manure 1,028 lb: NPK 4,357 lb. (unhusked cobs). Yams 1938. No Manure 4,973 lb: NPK 10,125 lb. At Umuahia, on the other hand, response has been small unless lime were also added e.g. Early Maize 1940 (lbs. per acre dry grain)

| | Limed | Unlimed |
|---|---|---|
| No manure | 858 | 87 |
| F. Y. M. | 1,376 | 735 |
| N. P. K. | 1,716 | 242 |

94. There has been a number of experiments on the acid sands of the Eastern Provinces with lime burned locally (Awgu). Its effectiveness has varied greatly from place to place. It may perhaps function in two distinct ways :- by direct displacement of other bases or by promoting nitrification and thus rendering minerals more available. Its effect in enhancing the value of added farmyard manure and artificials at Umuahia is clear. At Nkwele, where conditions for nitrification are possibly already satisfactory, its effect with artificials is small e.g. Early Maize 1939 NPK limed 4,775. NPK unlimed 4,357 (cobs). At Umuahia it has been found to promote the growth of Mucuna (limiting PH 5.0) but to have little effect on Calopogonium.

95. Rock phosphate is obtainable from Abeokuta. In contrast to superphosphate it has little effect on crop yields on the near-neutral soils of the North. It was hoped that it might prove effective on the acid sands of the Eastern Provinces or when used in the preparation of composts. Further experiments in this respect are needed. In early experiments on Eastern soils it had no direct effect on millet yields but increased the growth of a Mucuna cover which itself stepped up yields when dug in.

96. The issue of imported artificial manures to peasant farmers has been generally condemned on the ground that they are not economic. The costs of manuring with artificials relative to the costs of mixed farming and green manuring need thorough investigation. There were indications before the war that the use of artificials would pay handsomely in intensive agriculture in the Gold Coast. Shallot growers in the Keta area were paying £1.13. 6d. per ton for dried cow-dung and £4.10/- per ton for bat guano : the valuations of these manures in fertiliser units were respectively 12/3d. and £3. 5/- per ton. Comparative trials with local organic manures (cow-dung and fish meal) and artificials showed (1939) that an extra expenditure of £1 9. 6d. on artificials brought in an increased return of £10. 5/-. (The manures were valued at cost delivered to the field :- Sulphate of ammonia 18/- : Sulphate of potash 24/- : Superphosphate 16/6d. per cwt.).

97. Fertiliser trials in the Gold Coast have been regrettably few. With the higher prices prevalent for foodstuffs, artificials make a better financial showing than in Nigeria, where only the more spectacular results have been published in terms of pounds, shillings and pence, e.g. an application of ½ cwt. per acre of ammonium sulphate to early maize at Ibadan (B4W) in 1934 gave an increment of 470 lbs. dry grain over an unmanured yield of 1,000 lbs. per acre. Cost of manure (landed Lagos) = 3/9d. Value of 470 lbs. maize (3/6d. per cwt.) = 14/-. Translated into present Gold Coast prices this would read :- Cost of manure (landed Accra) = 9/-. Value of 470 lbs. maize (13/- per cwt.) = 52/-.

98. The cost of transporting manures to the farms often exceeds their landed cost. Subsidies in respect of transport might well be granted in ~~respect of~~ areas in the Eastern Provinces of Nigeria and in the Krobo District of the Gold Coast where extensive trials are most urgently needed. Whether the import of fertilisers should be subsidised by an export tax on oil-seeds is a question worth serious consideration if preliminary trials are found successful.

COMPOSTS.

99. Under primitive conditions plant wastes find their way to the soil as ashes, whilst faeces and urine stay close to the surface in or around the compound, which is of markedly higher fertility than the rest of the farm in districts such as Mamprusi. Under the system of sanitation now practised in urban areas excrement is usually

buried /

buried at great depths in latrine pits. The utilisation of faecal matter is one of the first problems which needs to be tackled.

100. Where there is house-to-house pail collection the problem presents no difficulty. A very effective system has been in operation in one of the suburbs of Kano for the past five years and has given an average output of 9,000 tons of compost per annum. It is eagerly bought at 1d. per donkey load (about 1/8d. per ton) and the scheme is self-supporting.

101. Owing to the present shortage of motor transport, lorries are used only for the dumping of street sweepings and garbage. Pans are head-loaded to the pits, one labourer making trips to 15 groups of five houses per day.

The street sweepings (leaves, etc.) are picked free from tins and glass and spread in a 6" layer on the mixing floor. A 2" layer of faeces is then spread, covered by a second 6" layer of garbage and the mixture worked to a thick paste. (The labourers' legs and feet are protected by wrappings). This paste is then spread on the floor of a concrete pit 10' x 50', and covered with a layer of dry sweepings; a small space is left to allow the pile to be turned. A second layer of paste and dry material is added the following day. There are 16 pits in the unit.

102. The first turning takes place after 5 days, when fly larvae have been driven by the heat of fermentation towards the top of the heap; they are effectively killed by turning the hot material over them. A second turning is given 10 days after the first and the manure is removed to stacks 15 days after the second turning. There was a complete absence of flies both over the pits and in the stacks.

103. Water is not easily available and is not added. In a series of pits in a second Kano suburb watering is being carried out to facilitate breakdown. At the Kaduna pits, which are kept uniformly moist by watering and roofing, higher fermentation temperatures and quicker breakdown have been obtained. Rapid breakdown is obtained by composting the offal and stomach contents from the Sabon Gari (Kano) abattoir.

104. Analyses of the composts were not available. They appear to give a performance similar to that of farmyard manure e.g. Kano 1945. Unthreshed Guinea corn lb. per acre.

| | | |
|---|---|---|
| No Manure | ... | 1,080 |
| Farmyard Manure | ... | 1,400 |
| Offal Compost | ... | 1,540 |
| Faeces Compost | ... | 1,760 |

The chief drawback of central compost factories is the cost of transport of such bulky materials where pack animals are not available.

SOIL REGENERATION.

105. A large number of comparative experiments using weeds, grasses, leguminous and tree covers to determine the optimum period of fallowing on different soil types are in progress in the South. The covers considered suitable for the Eastern Province are listed under O.P.R.S. (paragraph 27). Pigeon pea and a large number of grasses are under trial at Ibadan.

106. Pigeon pea which, by ratooning after the first year, can serve as a cover for three years, is being given extensive trial in the North. Experiments at Samaru include variety and spacing trials, and comparative trials with Kyasuwa (P.pedicellatum) over a fallow period of 3 years, cotton being used as test crop. There is also an experiment to decide whether it is economic to boost the cover by giving an application of 2 tons of farmyard manure per acre at the time of establishment.

107. A more ambitious experiment at Maigana consists of 25 soil treatments (replicated 6 times in a latticed layout) to be carried out for a period of 3 years and then given a test crop of cotton. The covers in use are (i) weeds (ii) Kyasuwa (iii) Pois d'Achery (iv) Mucuna (v) Elephant grass (vi) Pigeon pea. Various treatments of the covers include (a) leaving (b) cutting and leaving (c) cutting and removing (d) burning (e) manuring with 2 tons of farmyard manure per acre. Cotton, given 1 ton of farmyard manure per annum, is used as control: one treatment consists of cassava cropped for three successive years.

108. The varieties of pigeon pea under trial are :- Trinidad 1937, Pusa 69, Pusa 51, Pusa 24. Of these Pusa 69, which has a 'closed umbrella' habit and a large reddish seed is the most promising. Early maturation is a desirable feature since by local custom goats are allowed free browsing as soon as the guinea corn crop has been harvested.

109. Yields, at 3' apart on 3' ridges, are about 1,000 lb. per acre in the first year and 800 lb. per acre in the second. Pigeon peas are as yet not popular as an item of diet on account of the long period of boiling needed (see Soya Beans paragraph 206). During the war years a small trade in split peas was begun at Gusau. The possibility of export to the European famine zone will no doubt receive consideration.

SOIL CONSERVATION.

110. Broad-base terracing was first carried out at Daudawa Farm in 1936. When this farm was taken over from high bush in 1926 average yields were 400 lb. cotton and 800 lb. guinea corn per acre: they had declined to 149 lb. cotton and 433 lb. guinea corn in 1935. By 1944 they had been gradually restored to the 1926 level. As an annual application of 3 tons farmyard manure per acre was begun in the year that terracing was embarked on, it is difficult to assess the relative contribution of the two operations. Terracing has certainly smoothed out the differences in moisture content which previously existed between fields.

There /

There remain certain fields which are highly successful in a dry year but failures in a wet year, and it is believed that with present-day knowledge the original terracing scheme could have been made more effective.

111. The method of terracing used at Daudawa - a V-drag following a cattle-drawn plough - was demonstrated to us at Shika Stock Farm during the 1938 Conference. The Agricultural Engineer, who has recently toured anti-erosion works in South Africa, was carrying out handworked terracing on Shika Farm at the time of my visit. Terraces 17 ft. wide, with a scoop of 16", were being constructed at contour intervals of 2' 6"; due provision of water meadows to carry off unexpectedly heavy showers (over 2½") was being made.

112. Working costs on the upper slopes had been high due to the occurrence of ironstone induration; to the steep slope (4 per cent. in places); and to the dryness of the soil. . . 67 acres, with a terrace length of 10,223 yards, had been contoured between September 18th and November 30th at a cost of 4.48d. per yard or £3. 0. 6d. per acre. The cost per yard had varied between 5.4d. (ironstone) and 2.4d. (dry soil). As the sandy bottoms are approached the cost per yard will fall, whilst the cost per acre will be further reduced by the decrease in slope.

113. Major anti-erosion measures have been planned for the 'bad-lands' of the Eastern Provinces. I was unable to visit this area but was shown an impressive series of photographs of the gullying which has been produced on these deep sandy soils. Operations await the provision of men and machinery.

114. There have been no measurements of soil-wash and run-off and the Agricultural Engineer asked to be kept in touch with the lysimeter work now proceeding at Zuarungu.

## LIVESTOCK.

### CATTLE.

#### Shika Stock Farm.

115. The Stock Farm at Shika was established in 1928 with the object of improving the conformation and milking capacity of local breeds of cattle, the ultimate aim being to provide bulls of high milking strains for issue to nomadic herds, and to meet the demand for better quality beef in the South. For ten years two closed herds of 126 White Fulani and 50 Gudali were kept. There has been recent introduction of new blood, and total stock is now 750, including 400 adults.

116. Rations appear satisfactory, the latest introduction being dried blood which has given excellent results with unthrifty calves when fed at the rate of 4 oz. per day. Half an acre of arable land is allowed per head of stock and cropped in the ratio corn 2 : hay 1 : sweet potatoes 1. The rotation is (1) Guinea corn, (2) Mucuna, (3) Guinea corn (4) Green gram ploughed

in /

in before sweet potato: manured at 4 tons farmyard manure per acre. Soya beans planted 1' apart on 3' ridges have given a hay yield rather less than that of mucuna. For hay, as opposed to seed production, closer spacing or the introduction of fodder types which are said (Macmillan) to reach a height of 4 to 5 feet,* might be tried. Hay yields from the 9" x 9" plantings at Pokcase will be of interest.

117. The average milk yield for the herd is 250 gallons per lactation period of 320 days, the record being 500 gallons. Breeding has increased the number yielding 400 gallons or over from 2.5 per cent. to 10 per cent. Conformation is considered good. Experiments in castration have shown that entire and treated beasts are of equal weight: the entire animal works better, but the bullock gives beef of a better quality, the size and flavour of the prime cuts being markedly improved.

118. A serious outbreak of trypanosomiasis occurred at the end of 1944 when 200 head were suspect of infection and 15-20 per cent found positive (T.vivax 95 per cent: T.congolense 5 per cent). G.Tachinoides was found near the farm boundary, its presence in an abnormally dry season being attributed to anti-fly clearance of bush in the neighbouring village of Guga. Tartar emetic has been found useless against T.congolense and of doubtful value against T.vivax. Phenanthridinium is giving promising results in both cases.

119. Scour (B.coli & Salmanella enteritidis ?) in pail-fed calves has been shown to be aggravated by flies, incidence being reduced from 77 to 52 and mortality from 50 to 25 per cent in an experimentally screened pen. An autogenous vaccine prepared by the Veterinary Officer reduced mortality by 50 per cent but had little effect on incidence. Suckling seems desirable, but is difficult to carry out in conjunction with yield records. In a recent experiment the possibility of recording yield once weekly instead of daily is being tried out. Three sets of calves are treated as follows :- (i) Feed from all teats for 6 days - starved on 7th (recording) day. (ii) Feed from 2 teats only (iii) Feed from 2 teats via pail. Calves in treatment (i) were markedly bigger than those in treatment (iii).

120. /

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* The yellow seeded variety, Malaya, is said to have grown to shoulder height at Zonkwa. This variety grows only knee high in the Northern Territories of the Gold Coast. It has been reported to give an excellent ground cover in Northern Ashanti.

120. The closed Shika herds had a low abortion rate of 3 per cent. Consequent on the introduction of new stock the rate rose in 1943 to 9 per cent., and many cases were recorded in Shika cows sent to the Lagos Dairy. This Dairy is now stocked from Samaru, where a tested herd is being established. The herd is tested weekly and positive cases slaughtered. Testing will continue for 3 months after the last positive case of contagious abortion is discovered.

121. Pleuro-pneumonia. A triple vaccine is proving effective.

| | | | |
|---|---|---|---|
| Injection 1 | Attenuated | Kenya strain. | In Dewlap |
| 2 | " | Nigerian " | In Tail |
| 3 | Virulent | " " | In Tail. |

Intervals of 6 weeks between injections.

Ilorin Stock Farm.

122. At Ilorin farm the inheritance of resistance to trypanosomiasis is being studied in Gold Coast Shorthorns and N'damas. Deaths in the Shorthorn herd have usually been traceable to low resistance in one of the parents; the offspring of selected dams and sires are showing a greatly enhanced resistance. A great increase in calf size has been effected by crossing Gold Coast with Nigerian Shorthorns. Crossing N'dama with Nigerian Shorthorns and Borgawa is planned when sufficient N'dama stock is available. One undesirable feature of the N'dama is the long period (about 480 days) between calves. There are indications that this interval may be reduced by alterations in management.

123. A necessary preliminary to the upgrading of the dwarf cattle which at present roam freely, to the detriment of crops and village sanitation, is their collection into herds. The building of kraals and the provision of herdsmen are being undertaken by the Department in some of the Southern Provinces (e.g. Ondo). A pure herd of Nigerian shorthorns is maintained and worked at Moor Plantation. They have been found difficult to train, and yield a very small quantity of manure.

P I G S.

124. Early in the war the production of bacon and pork for the Nigerian market was undertaken by the Veterinary Department, who during the 4½ years ending December, 1944, had produced 160,000 lbs. of bacon and 125,000 lbs. of fresh pork. The Agricultural Department took up large-scale pig-keeping in 1941, partly to supplement the Vom production of bacon, sausages, etc., and partly with the object of introducing improved pigs into native husbandry and diet. It was hoped that local pig-keepers would eventually relieve the Department of the need for mass production, leaving the Department free to concentrate on experimental work. Privately owned piggeries have accordingly been fostered, and their pigs marketed by the Department. Weaners for fattening have been bought from supervised peasant farmers supplied with breeding stock in Anchau and Bauchi.

125. /

125. The aim has been to breed to a Large White type, which runs to fat less readily than the Middle White. Available breeding stock of bacon type consisted in 1941 of only 16 mature sows and 67 gilts of mixed English breeds. By the importation of 59 sows of European origin from the Cameroons and of 18 pedigree Large White boars from English herds (landed cost £90 each) breeding stock was rapidly multiplied and is now stabilised at 400 boars and sows. Total stock in the six Northern piggeries (Shika, Samaru, Bauchi, Minna, Zonkwa, Daudawa) is 3,200, valued at £11,000. Few traces of breeds other than Large White are apparent in the present stock.

126. The production of 400 pigs per month for the Lagos market, the target originally aimed at, has recently been achieved: railings were 1,261 in the three months August-October, 1945. Local sales were 256 for the first six months of 1945. Weekly railings are made to Lagos, where carcases are handled by West African Cold Storage, Lagos, and Messrs. John Holt, Ebute Metta, who pay 8d. per aconers lb. live weight free on rail for ~~bacon~~ and young porkers; 6d. per lb. for old porkers (sausages). Locally killed pork is sold at 11d. per lb. dressed carcase.

127. The stock is kept in unscreened sties, without any obvious detriment during the dry weather when my visit was made. Flies were remarkably few in the Northern pens though more numerous in Ibadan. Here fly infestation is a serious problem between June and mid-November. Between 4,000 and 5,000 flies (95% Stomoxys spp.) have been trapped in 12 pens during a period of 24 hours, a total of 250,000 (30% Stomoxys) being caught in 12 pens at Ibadan during 1943. The Senior Entomologist has found 'Ephesticide' (Flake rubber (Ate) 3 : Shea butter 1) an effective fly-catcher. It is smeared on lengths of telephone wire which have the advantage over the piassava strands formerly used against cocoa-moth that they can be re-coated after burning off the flies. A great reduction in the incidence of flies in Ibadan houses has been effected by a regular issue of these fly-catchers to kitchens.

No serious occurrence of Trypanosomiasis has apparently been recorded, although it has been suggested that the demise of the entire stock of 8 pigs at Ondo Farm in November, 1945 may have been caused by T.simiae.

128. Some of the complaints from which pigs have suffered are :-

(i) Iodine Deficiency. Particularly prevalent at Minna where goitre is common. Symptoms are trouble in farrowing with occasional deaths, and the production of hairless offspring. One grain of potassium iodide is fed daily to all sows (1 ounce KI in 1 gallon water : dose 1 teaspoonful per day).

(ii)

(ii) Posterior Paresis. Paralysis of the hind-quarters has occurred, particularly in young sows, during the dry season when green-stuff is in short supply. It is believed due to avitaminosis (A). Rapid response to green feed is obtained. Palm-oil is now added to the ration at the rate of 8 oz. per head per day. Paresis has, however, occurred in animals receiving palm-oil. A supplement of liver is being tried at Minna.

(iii) Rash occurs when too large a proportion of palm-kernel meal is fed. It is quickly cured by omitting palm-kernel meal from the diet.

(iv) Mange. Regular dipping of adults is needed. Affected piglets are smeared with palm-oil.

(v) Ringworm. Local treatment with iodine. Sterilisation of pens by blow-lamp.

(vi) Prolapsed Anus. Caused by too dry a feed.

(vii) Piglet Mortality. Average for 5 farms 1943: 19.5%. Significant increase to 23-26% in February, July and October.

129. Many experiments were made before a satisfactory diet was evolved. Animal protein was found essential to rapid growth. Skim milk has given excellent results, and serious troubles at Minna have been usually associated with a suspension of supply (cf. also French, M.H. East African Journal X, 4, 234). Dried blood meal has given some amazing results in a number of controlled feeding trials at Shika. Fed at the rate of 1 oz. per day (2 oz. gave no further increment) it gave a weight increment of 117% over controls, and reduced the fattening period (to 180 lbs.) from 44 to 28 weeks. Reckoned in terms of live weight production at 8d. per lb. 1 ton of blood meal had an intrinsic value of £800 per ton. The average age at which bacon pigs left Zaria was reduced from 42 weeks in November, 1943 to 28-29 weeks in June, 1944.

130. It seems surprising that at Pokoase and the Army Pig Farm, where skim milk is not obtainable, and where blood meal, rarely available, is fed only to suckling sows and not to fatteners, the rate of increase is the same as in the Nigerian piggeries i.e. with no addition of animal protein to the diet a pig of 180 lbs. weight is habitually produced in 24 to 28 weeks. (A trace of animal protein may be added in the bone-meal, which is made from only partially burnt bones (boiled bones in Tamale) and may contain about 1 per cent. of nitrogen. In a 3 lb ration the weight of nitrogen would be 1/100 oz. compared with 1/9 oz. Nitrogen in 1 oz. blood-meal).

The rations /

131. The rations used at Minna are given below :-

Suckling sows and weaners.

| | With Skim Milk. | Without Skim Milk. | All other pigs. |
|---|---|---|---|
| Guinea Corn ..... | 6 | 6 | 14 |
| Palm-kernel meal ..... | 4 | 2 | 2 |
| Cowpeas ..... | 4 | 4 | 2 |
| Groundnut Cake ..... | 1 | 3 | 1 |

Mineral Mixture. To form 3.7 per cent. of ration. Ground bone ash 18: Lime-stone 6: Salt 9: Kanwa 3: Charcoal 8.

Supplement. 8 oz. palm-oil: 1½ oz. blood meal per head per day.

132. The rations in use at Pokoase and Army Pig Farm are as follows :-

| | Weaners (P) | Fatteners (P) | General Ration (Army Pig Farm) |
|---|---|---|---|
| Maize ..... | 50 | 64 | 50 |
| Cowpeas ..... | 20 | 18 | 5 |
| Groundnut Cake ..... | 10 | - | Nuts 10 |
| Palm-kernel ..... | 10 | 10 | 20 |
| Brewers' Grains ..... | - | 7 | 15 |
| Salt ..... | 1 | 1 | 1 |
| Limestone (Shell) ..... | 2 | 3 | Soil 3 |
| Bone Meal ..... | 2 | - | 2 |
| Wood Ash ..... | 2 | 3 | 3 |
| Charcoal ..... | 1 | 1 | 3 |
| Palm-oil ..... | ½ gallon | ½ gallon | ½ gallon. |

133. I failed to obtain figures showing the cost of the Minna ration per added lb. of live weight. The daily consumption by boars and dry pigs was said to be 5-6 lbs. per day and of suckling sows and gilts 10-12 lbs. per day. These figures are in agreement with Pokoase figures and it can be assumed that, as at Pokoase, the consumption during the weaning stage is about 3 lbs. and during the fattening stage about 5-6 lbs. per day.

Minna prices are :-

Palm-kernel meal ..... £ 5.10. 0d. (Apapa £2.10. 0d.)
Groundnut cake ..... £10.12. 0d. (£7 Kano)
Cowpeas and Guinea-corn about ..... £6 - £8 per ton.

A very satisfactory profit can apparently be made by selling at 8d. live weight. The Assistant Director, Northern Provinces, has estimated that, discounting the cost of European supervision, the six Northern piggeries made a working profit of £10,000 in 1944-45.

134. /

134. The normal practice at Minna is to castrate at 6 weeks. Gilts are first served at 9-10 months. Boars were, to their detriment, originally asked to serve 3 times weekly: with increased stock services have been reduced to 30 per annum. The number of piglets reared per sow has been reduced to 9: in the early days litters of up to 14 had been kept. At Samaru gilts and dry sows are given exercise, and turned out to grass in the day time.

135. The Lagos curing industry, which has so far absorbed the bulk of the Department's pig production, will need to produce uniformly high class bacon and hams if it is to face outside competition without protection. I heard a number of complaints against the quality of the bacon now being made in Lagos. It is possible that the firms now undertaking curing will at some date be equally interested in the sale of imported bacon and hams. During December the demand from Lagos was disconcertingly lower than the quota of 400 ready for railing. Private piggeries (there are seven, including one of 250 head at Kano) will shortly be producing 200 pigs per month, and they are to be given precedence in railings. The Department proposes as a first measure to close the Zonkwa piggery and concentrate the best blood at the remaining centres.

136. It is not expected that there will be immediate difficulty in disposing of surplus stock as fresh pork. In Zaria district there is an unsatisfied demand for pork by Yorubas and pagans at 11d. per lb. In Niger Province (Minna), where there is an estimated native pig population of 20,000, disposal may not be so easy, as the local price of pork is said to be about 5d. per lb. The Nigerian piggeries are not so fortunate as our own in being near a large consuming centre. The possibility of preparing pickled pork for export to other West African colonies is now under consideration.

137. It is early to say what progress can be expected in the improvement of native stock under peasant management. At Ibadan stock containing ¼ native blood is being bred for distribution. The tenant of the one Unit Farm to which pigs had been issued appeared to be keeping them on the short commons on which our farmers expect pigs to thrive. It is realised that it may not be wise to use only the Large White as European parent and that it may later be advisable to bring back Middle White or other breeds. A Duala importation, which has Essex characteristics and is an economic feeder, is being watched with interest at Shika.

SHEEP AND GOATS.

138. Nigerian experiments in sheep-breeding have not been highly successful. I saw no flock as flourishing as those of our Central Provinces, which are fed mainly on Centrosema, whose virtues were extolled by us at the 1938 Conference.

139. /

139. Reference has been made to the failure of stall-fed goats under the Kano Unit Farm Scheme. Experiments made at Sokoto showed that compared with penned animals goats on free range have a higher birth-rate and a lower abortion - and death-rate. It was thought that leaves of certain bush-plants were needed to keep the goats in good condition. An average milk yield of 70 lbs. over a lactation period of 117 days was obtained at Daura; the best nanny produced 159 lbs. in 167 days. At Onitsha the best yields have been 160 lbs. in 119 days and 233 lbs. in 194 days. The quality of goat manure is said to be high; no details of yield per animal were available.

## D A I R I E S.

### (a) North.

140. Dairies relying on daily supplies of milk from groups of mixed farmers and Fulani herdsmen have operated very successfully in many parts of the Northern Territories. Notably at Kano, Maiduguri and Zaria; at each of these places upwards of 100 bottles of pasteurised milk have been sold daily. The N.A. Dairy at Kano at one time produced 400 bottles per day, but it was later necessary to divert supplies to butter-making. This dairy has marketed an average of 50,000 lbs. of butter per annum during the past three years. There has also been a small trade in cream cheese.

141. There seems no reason why the butter industry should not be developed after the war for the benefit of other West African Colonies, once regular shipping facilities are available. Butter-making has the following advantages over a fresh-milk trade :-

(i) Skim milk can be returned to the stock, thereby reducing the danger of weakening the calves.

(ii) Butter can be marketed more easily than milk, and with the provision of normal cold-store accommodation the risk of contamination is small.

(iii) Any surplus can be converted into clarified butter fat, for which a good export market existed before the war.

142. Whilst milk is a desirable addition to native diet it is difficult to decide how far one could afford to organise a trade in fresh milk. Unless distribution is closely supervised it will be difficult to prevent adulteration by water at times of seasonal shortage; five samples collected from the uncontrolled milk trade in Maiduguri in early 1944 contained added water, ranging from 15 to 36 per cent. Milk is an excellent medium for bacteria, and adulteration by polluted water might have serious consequences. It has been suggested that the Fulani practice of consuming curd rather than fresh milk may have been inspired by the inability of a number of pathogenic organisms (including those of bacillary dysentery, cholera and typhoid) to tolerate an acid medium (Nutrition in the Colonial Empire, page 81). It would, therefore, seem wise, unless processing can be undertaken, to confine the consumption of fresh milk to the producing areas.

(b) South. /

(b) South.

143. A stall-fed milk cow housed in a fly-proof byre was demonstrated to us at Moor Plantation in 1938. During the war screened byres stocked with selected Zebu cows have been set up in a number of southern towns (Lagos, Ibadan, Benin, Okene) to supplement the milk ration and to provide fresh milk for military and civilian hospitals; 100 cows were supplied for stocking a similar dairy opened by the Veterinary Department in Accra in 1943.

144. With the exception of an outbreak of contagious abortion in the Lagos Dairy (see para. 121) the cows have remained in good health, and milk yields, about 5 lbs. per day, have been satisfactory. Difficulty has been experienced in securing effective services by the bull, and it is believed that some measure of exercise is needed to make the cow receptive. At Ibadan the cows are now let out at 7.30 p.m. to roofed pens, where green fodder is stacked on racks; they are returned to the screened byres at daybreak. In Lagos it has been found more expedient to send dry cows back to Samaru in exchange for cows in milk. This measure has in part been dictated by the need to establish a tested herd at Samaru.

145. The Lagos price for milk is 6d. per pint wholesale and 8d. per pint retail. The Lagos Dairy contained 58 cows at the time of my visit, and the output was 27 gallons per day. It can obviously supply only a fraction of the community, and priority has been given to children and hospital cases. It is not claimed that the Southern dairies are self-supporting: regular veterinary attention and provision of railway transport are services which a private dairy farmer could doubtfully afford. It should, however, be remembered that the trade is a luxury one, and that there is a fair margin between 8d. and 1/1d., the pre-war retail price for imported pasteurised English milk. A Syrian dairy farmer has operated (presumably not at a loss) in Ibadan over a period of five years.

CATTLE FATTENING.

146. The fattening of working cattle and extra beasts for the meat market has during the war brought in a large part of the mixed farmer's income. The Army has been supplied in the North with beef of good quality. Fattened cattle railed to Lagos have, however, lost so much weight during the journey that Lagos beef has been of a low standard. In April, 1944, a Stock Fattening Scheme was started at Agege (15 miles north of Lagos). Railed cattle were to be fattened locally, slaughter tests being carried out to determine the optimum age and type of beast. Fattening in the South has the advantage that green fodder is available throughout the year and prices of palm-kernels and cotton-seed are low.

147. /

147. The farm consists of 250 acres and has been planted with various fodders. Seven screened sheds have accommodation for 170 cattle which are stall-fed on concentrates and green stuff. Provision was made for the regular railing of one wagon of 24 cattle per fortnight.

148. The scheme has suffered several setbacks, the most serious being the strike of June, 1945, when the farm served as a cattle reserve for Lagos, and at one time housed 450 head. The scheme was being overhauled at the time of my visit, and fattening costs were not available. Selling prices of fattened cattle were 3½d. per lb. live-weight; 4½d. dead-weight and 7½d. dressed carcase.

PASTURES AND FODDERS.

149. Nigerian pasture and fodder research is to be the subject of a technical report by Mr. J.H. Hinds, who left for Nigeria soon after my return to Accra. These notes are of only a general nature.

150. In the classification of local grasses Nigerian work appears no more advanced than our own: the identity of many of the Northern and Southern grasses is still being worked out. There have, however, been a large number of importations of pasture and fodder grasses, and at most experiment stations there is a series of plots to test the effect of cutting, annual yield, survival during dry season etc., of the types most promising under local conditions.

151. The use of grasses in soil regeneration, and the application of manures has been briefly discussed (para. 108). Applications of 1, 2, 3, 4 tons farmyard manure per annum were made at Maigana over a period of six years on a ley of elephant grass. Maximum yields of green fodder were obtained in the second year after planting: thereafter they declined (second year 12,800 lbs.; sixth year, 4,000 lbs. at 1 ton farmyard manure). Yields throughout varied directly as the rate of application of manure, the annual increment of green fodder corresponding to 1 ton farmyard manure being 1,000 lbs. over the six year period. The effect of lime (1 ton per acre) and farmyard manure (4 tons per acre) on (i) Molasses grass (ii) Centrosema (iii) Setaria megaphylla (iv) A.gayanus (v) A.tectorum (vi) Guinea grass, was determined at Umuahia in 1944. Large increases due to farmyard manure were observed with all fodders, and there was little or no further increment from lime plus farmyard manure. Lime alone gave substantial increases only with the two Ganba-grasses and guinea grass. The experiments were not replicated.

152. Mucuna still remains, with sweet potato tops, the most valuable dry-season fodder in the North, and at Samaru there are variety trials in progress to try to find a type which will remain green throughout the dry season and possibly re-seed itself. Sunflowers were grown as a war export venture, and the surplus is being used in

making /

making silage: a mixture of 3 parts sunflowers, newly flowered, and 2 parts soya bean, cut at the snap pod stage, appeared promising. Lucerne survives the dry season at Samaru; it has flowered but has not set seed; it can be propagated for trial by root splitting. I brought back from Samaru samples of a newly arrived Palestine Lucerne and mixed seed from South African lucernes seeding at Ibadan. I also brought seed of Lupinus termis but was unable to obtain seed of Sulla (Hedysarum coronarium), a fodder newly introduced from Malta.

153. The exotic Star-weed, Acanthospermum hispidum, which is a serious enough pest in our Northern Territories, is particularly prevalent in the Kano area, where large areas of grazing have been ruined. Tests made in 1944 showed that 5% sulphuric acid would destroy the weed without damaging the pasture grasses. In 1945 comparative tests were made with acids of 5, 3.3 and 1.7 per cent. strength. Three monthly sprayings (July, August, September) at 200 gallons per acre were made. At the time of my visit the 1.7 per cent. acid appeared to have been as effective as the 5%. The cost per acre for treatment with the weakest acid was :- acid £11; labour £4. (These figures would suggest that the sulphuric acid, bought in small quantities, had cost 22/- per gallon (10 gallons = £11). The Senior Chemist had obtained home quotations of £6.12/- per ton or about 1/- per gallon of 18 lbs. Allowing an increase of 100% for transport the cost for acid should not exceed £1 per acre, and it seems likely that with mobile spray equipment a very large reduction in labour costs could be effected).

154. Trials with a proprietary weed-killer, Methoxone, were in progress on a small scale. It was too early to judge its efficacy. Flame-throwers which, if used in the correct season, might prove very efficacious, have not been available; their use has been advocated by a number of pyrotechnicists, including Mr. Hinds and myself. Acanthospermum hispidum (more commonly known under its telling Hausa name of Kashin yawo) was listed under noxious weeds in Nigerian Gazette No.56 of 28th September, 1944.

155.

## POSSIBLE EXPORT CROPS.

### RICE.

155. The rapid expansion of Nigeria's rice industry during the war years has been briefly described (para. 7). With continued development it is likely that Nigerian rice will soon be available for the world market.

I saw rice-growing only in swamps at Ondo, one of the last Provinces to which the Department has introduced the crop; the irrigation works near Bida were not completed at the time of my visit. In Bida Province rice is a traditional staple, and in many places it takes the place of guinea corn; it is generally eaten after boiling whole, though sometimes made into pap. The native red rices have

been /

been largely ousted by G.E.B.24, which tillers and has a more popular flavour. G79, which gives about 2,000 lbs. paddy per acre as against 1,000 lbs. for the native varieties, is rapidly gaining favour. (G79 gave a yield of 4,000 lbs. paddy per acre at Daudawa in 1943).

156. The present Badeggi (Bida) Mill was fitted with a 25 h.p. engine in January 1945 and consists of two No.7 Grant Huller-Polishers and a separator. The plant is used for cleaning rice husked locally in mortars. It has a capacity of 2 tons per day and handled 360 tons dirty rice in March-November 1945, with an out-turn of 270 tons whole milled rice. Native-prepared rice is bought for the factory at a commission of 10/- per ton by Messrs. John Holts and United Africa Company who paid £11.13. 4d. per ton in 1945 as against £9. 6. 8d. in 1944. Clean rice was sold ex factory for £17.16. 8d. per ton in 1945 and £15.10/- in 1944. Prices for broken rice and bran were respectively £15.10/- and £3.10/- per ton in 1945.

157. A survey of the Gold Coast rice industry was made by Mr. R.R. Glanville in October, 1943. It was estimated that annual production then amounted to 3,000 tons of clean rice surplus to the requirements of the growers. Pre-war imports to the Gold Coast were 12,000 tons at £15 per ton. Mr. Glanville considered that sufficient suitable land was available to make the Gold Coast self-supporting within a few years if the price could be maintained at upwards of £15 per ton. He considered the prevalent retail price of £37 per ton (Sekondi) to be a luxury one in relation to staples such as cassava and maize, and pointed out that the survival of the industry after the war would probably depend on the degree to which increased production brought down prices towards the level of Sierra Leone (and Nigerian?) export prices.

158. Since Mr. Glaville's report rice production has been greatly increased. In November, 1945, total production in the Gold Coast was estimated at 9,000 tons clean rice per annum. There has, however, been no indication of a fall in prices. Prices paid per ton of clean rice to producers in the main growing areas were then :- Togoland £27: Ashanti £29-£37: Western Province £38. In the Eastern Province (production small) the price received by producers has been as high as £65 per ton, and the retail price has at times reached 8d. per lb.

159. There has been a parallel increase in the price of staples since Mr. Glanville's visit, and it is early to prophesy the price level at which farmers are likely to abandon production when food prices return to normal. It is clear that we are not likely to compete in the export market for a number of years to come.

160. /

## ONIONS.

160. Pre-war production of Nigerian onions for local supply was on a large scale. It has been expanded to meet military requirements and a considerable surplus should presently be available for export. Railments in 1944 were 2,022 tons. A request for supplies for Sierra Leone was then refused, as it was considered that exports would affect local supplies.

161. There are four main producing areas :-

(a) Kano. The main crop is planted in the dry season, the harvest begins in February, and peak production occurs between March and September. The onion is large, white and flabby, and does not store for more than three months.

(b) Sokoto (Gusau). A dry-season crop, harvested between February and June. The onion is small and firm and stores well.

(c) Zaria. There are two crops :-

(i) Dry-season - large flat onion harvested in January-April; crop small.

(ii) Wet-season - a round onion with reddish skin, peak period October-December.

(d) Middle Niger Valley. A dry-season crop of large long onions, white or brown, harvested between December and March.

162. Regular consignments were made during 1942 to the R.A.F., Takoradi. Losses in transit were at first heavy but they were finally reduced to 7 or 8 per cent. by improved methods of packing and drying. The following estimate of the cost of Nigerian onions landed at Takoradi is based on costings of two consignments of 7 cwts each sent from Gusau in 1942 :-

Cost per ton.

| | |
|---|---|
| To Grower (6/6d. per cwt.) ..... | £ 6.10. 0d. |
| Baskets 40 @ 5d. ..... | -.16. 8d. |
| Twine and handling ..... | -. 6.10d. |
| Railway freight Apapa ..... | 3. 0. 0d. |
| Ocean freight Apapa-Takoradi ..... | 1. 8. 9d. |
| Surcharge (50%) ..... | -.14. 5d. |
| Harbour charges, stamp. etc. Apapa and Takoradi ..... | -.15. 0d. |
| Middleman and Handling ..... | 3. 0. 0d. |
| | £16.11. 8d. |

163./

163. The growers' price quoted for Gusau in 1942 appears to be much lower than recent prices. Railings of the Zaria wet-season crop were :-

| | | | |
|---|---|---|---|
| 1941-42 ... | 455 tons | @ 10/- | per cwt. |
| 1942-43 ... | 456 " | " 15/- | " " |
| 1943-44 ... | 366 " | " 24/- | " " |

The crop in 1943-44 was an unusually poor one. An average price is about 15/- per cwt. which would mean a landed post Gold Coast of about £25 per ton or 2.7d. per lb. Pre-war (1939) imports of onions into the Gold Coast were 400 tons valued at £10 per ton.

POTATOES.

164. Pre-war imports of potatoes into Nigeria were about 500 tons per annum, at a landed cost of £12 per ton, or 1.3d. per lb. For some years prior to the war there had been production on the Plateau (Jos) and in the Cameroons, which satisfied only local demands. An increased demand for potatoes for supply to the Forces and to other West African Colonies was envisaged in 1940, and a target of 1,000 tons was aimed at. Exclusive of local consumption railings from producing centres were :- 1941. 638 tons: 1942. 825 tons: 1943. 1,451 tons. Present production, including consumption in producing centres, is estimated at 1,700 tons per annum. Consequent on the withdrawal of military personnel there will be a large surplus available for export. The chief producing centre is still Jos, but there has been a big increase in production in Zaria Province, and it is likely that the bulk of future production will come from Zaria, since the crop needs manure, and the relations between Fulani and Hausa are more cordial in Zaria than on the Plateau.

165. The varieties tested include King Edward, Arran Banner, Great Scot, Irish Cobbler, Up to Date, Craig's Defiance. The last two varieties have been found most satisfactory, Craig's Defiance being the earlier sprouter. 90 tons of imported seed were distributed in 1943, and the present policy is to multiply new introductions at Samaru Farm before distribution. With 2 tons of f.y.m. per acre, crops of up to 4 tons per acre have been grown; a crop of 2 tons per acre gives an adequate profit at 1d. per lb.

166. The main wet-season crop is harvested in July-October in Jos, and in August-November in Zaria. There is a regular seasonal glut in October-November, when the wholesale price is less than 1d. per lb. A smaller dry-season (irrigated) crop is harvested in February-March. The February-June wholesale price is 4d. to 6d. per lb. Attempts to smooth out production have not been successful. Despite a loss of 50% during storage a profit of £97 was made at Guga on 25 tons of potatoes bought at ¾d. per lb. in September 1944, and sold at the current price of 3½d. per lb. in January 1945. The most efficient method of storage yet tried is in banks of slatted trays fitted with corner-posts which allow circulation of air between one tray and the next. The trays are stored in a double-walled hut, and rotting potatoes discarded at frequent intervals.

167. /

167. There have been regular railings to Lagos, and quality has been high since Grading Regulations were introduced in August 1942. Lagos prices have been about 1d. per lb. above growers prices. Slatted wooden cases to hold 56 lbs. cost 2s. 2d. each and have now been replaced by baskets costing 6d. each. Consignments of 10 tons in September, 1941 and 1 ton in August, 1942 were made to the Gold Coast and arrived in good condition. The following estimate of landed cost, Takoradi, is based on consignments bought in Jos in 1941.

COSTS PER TON.

| | | |
|---|---|---|
| To Grower | (1.5d. per lb.) | £14. 0. 0. |
| Baskets | 40 at 6d. | 1. 0. 0. |
| Transport to Rail | | 1. 0. 0. |
| Handling charges, Inspection etc. | | 2.12. 0. |
| Railway freight Apapa | | 3. 0. 0. |
| Landed Lagos (Apapa) | | £21.12. 0. |
| Ocean freight Apapa-Takoradi | | 1. 8. 9. |
| Surcharge (50%) | | -.14. 5. |
| Harbour charges, stamp etc. Apapa | | -. 7. 6. |
| do. do. | Takoradi | -. 7. 6. |
| Landed Takoradi | | ~~£23.18. 2.~~ £24.10.2. |

The above charges would need to be increased by about £1 per ton if the supervision now exercised by the Department were undertaken by private persons. Handling charges at Apapa and Takoradi would amount to about £2, giving a landed price of about £27 per ton or 3d. per lb.

168. Pre-war imports of potatoes into the Gold Coast were 600 tons per annum at £12 per ton. Our local production is 70 tons per annum at a wholesale price of 4d. and a retail price of 6d. per lb. We could, therefore, absorb a part of the Nigerian surplus available during the months of August-December. Imports from other sources would be needed during the rest of the year, when production is not likely to be economic in Nigeria itself.

B A N A N A S.

169. At your request I interviewed Mr. F.E.V. Smith, Development Secretary, at the Secretariat in Lagos. I told Mr. Smith that the revival of our banana exports was under consideration, and that before any shipping contracts were made we wished to find whether Takoradi, given suitable cold storage, could be served by the fleet which would carry bananas from the Cameroons.

170. /

170. I gave Mr. Smith a short history of our bana- trade from 1936 to 1941. Early shipments, which consisted almost entirely of Cavendish bananas, had consistently failed to pay : the first small profit had been made at the beginning of 1939 when the percentage of Gros Michel bananas had risen from 8% to 52%. If the industry were revived our exports would consist entirely of Gros Michel.

171. Production would probably be in the neighbourhood of 100,000 bunches per annum, rising to 200,000 bunches in 2 years. There was considerable interest amongst the farmers themselves, who appeared satisfied with the pre-war price of 1/- per 9-hand bunch. The contract shipping charge, never lower than 2/- per bunch, had seemed high compared with total costs e.g. in one of the more successful shipments (No.21/38-39) costs per bunch were :- local 16.15d : shipping 24d : England 12.89d : Total 53.04d. Receipts 55.04d.

172. Mr. Smith said that he could not state with certainty what the future of the Cameroons banana trade would be until it had been decided how the country was to be administered. If Nigeria were made responsible he thought a contract for handling the whole of the Cameroons crop would be given to one of the Banana Companies. The shallow draught of boats serving the Cameroons would limit their capacity to about 80,000 bunches. Running a weekly service the Company would need upwards of 4 million bunches a year for successful operation ; it was thought that the Cameroons could produce this quantity.

173. Mr. Smith thought no company would be attracted by the prospect of taking on an extra 2,000 bunches a week at Takoradi. At 2s. 6d. a bunch the receipts would be £250. Against this must be set the extra mileage and loss of time in diverting the ship; the danger and expense of opening the cool-rooms two or three days after loading the main cargo (or the provision of a separately insulated cool-room); and the payment of harbour dues. The last item alone would probably be prohibitive, as the banana boats would have neither the time nor the facilities for handling cargo other than bananas.

174. In Mr. Smith's opinion our only hope of shipping bananas would be to make a contract, as heretofore, with a line whose ships worked Takoradi regularly. The charge of 2/- per stem did not appear excessive; as far as he remembered, pre-war charges in the West Indies were between 2s. 3d. and 2s. 6d. per stem. The Custodian of Enemy Property had paid 2s. 6d. per stem for Cameroons bananas shipped to the United Kingdom in 1939-40.

175. Compared with our local price of 1/- per 9-hand bunch Jamaica producers were now being paid 4s. 6d. free on rail, which would be about 5s. 9d. f.o.b. It should be remembered that these were boom prices.

176. /

SPICES.

176. Nigeria has made two notable efforts to enter the spice trade. An industry in cured white ginger has been nursed in Southern Zaria since 1930: exports reached a maximum of 380 tons in 1935. Despite an exacting system of grading the product failed to meet trade requirements. The area under crop was therefore restricted in 1939, when by carrying out chemical analysis in the field the ginger was brought to B.P. standard for the first time: exports in that year were only 85 tons.

177. Yellow ginger has been grown from 1940 onwards and about 50 tons per annum were exported between 1941 and 1943. It has been found easier to cure than white ginger, and quality has been well up to standard, although it has never secured the price paid for Jamaican ginger of the same grade. Supervision of preparation and regular analysis have been needed; in recent years exports have been reduced by local demand, and it was necessary to advance the price from 4d. to 6d. per lb. Grade I in 1944-45. It is doubted whether cured ginger is now a payable proposition, and it is proposed to permit the export of rough scraped ginger, trial consignments of which have received favourable reports.

178. Trial shipments of Japanese (Birdseye) Chillies, made in 1941 after a careful programme of selection and breeding, received most encouraging trade reports. Exports, mainly from Oyo and Benue Provinces, were 25 tons in 1942-43, 83 tons in 1943-44 and 122 tons in 1944-45. The crop pays well, yielding 5 to 6 cwt. per acre at £4 per cwt. Nigeria hopes to retain a share in the post-war market. The market is a restricted one and we are advised not to compete. With Nigeria's experience of the exactions of the spice market we may assume that this advice is disinterested.

OTHER CROPS.

CITRUS.

179. I examined as many citrus farms as possible to see whether I could find any cases of the 'sudden-death' which has occurred on sweet citrus budded on Sour Orange at Asuansi or of the general die-back from which limes in Abakrampa-Aseou are suffering. Citrus plots were inspected at Agege, Ibadan, Owena, Benin, Samaru and Kano.

180. Sour Orange is in general use as a stock both with budded plants imported as such (Moor Plantation Y 5) and with buddings made locally on stocks grown from seed imported from Florida and Trinidad. (Open pollinated seed produced in Nigeria from these importations is now being used for the production of stocks at Asuansi.)

No..

No case of sudden death has been observed. The only comparable symptoms, the production of small chlorotic leaves and die-back of branches, were seen in one Sweet Orange budded on Rough Lemon (M.P. Stock Trial A6).

181. There were few cases of chlorosis. There was marked mottling and poor growth in two Satsuma-Trifoliate orange trees (M.P. B6). This would appear due to incompatibility : similar symptoms occur on a grapefruit - Citropsis budding at Asuansi. Mild chlorosis was apparent on a few leaves of healthy Sweet Orange - Rough Lemon and Grapefruit-Rough Lemon trees at Ibadan. At Samaru a general spotted chlorosis which the Botanist had thought due to mineral deficiency appeared to arise from insect damage, punctures being visible in the centre of the spots. Basal yellowing noticed at Samaru on Grapefruit-Rough Lemon in the dry season was also apparent on mango and is probably seasonal.

182. Pruning wounds on most farms were clean, the practice being to treat immediately with Solignum and again after an interval of 14 days. The exception was Owena where the number of hacked and broken branches was no less than on our lime farms : no serious consequences have ensued. No bracket fungi were seen on any farm. At Moor Plantation there were two trees, Sicilian Lemon and Grapefruit, on Rough Lemon stock, which had fallen down; no fungus was found on the roots.

183. Dead lower branches, ascribed by Shepherd at Asuansi to interlocking, occurred chiefly on the larger trees e.g. Lemon-Sour Orange at Ibadan, and although the trees (27' x 27') were not yet touching, death may, as Shepherd has suggested, be due to lack of light. At Owena branch die-back has been connected with a severe dry-season.

184. Periodic records of gummosis are kept at Agege and Moor Plantation. West gives the average incidence on stocks at Agege as :- Sweet Orange 75% : Mandarin 75% : Tangelo 50% : Grapefruit 48% : Acid Lime 45% : Tangerine 40% : Rough Lemon 34% : Shaddock 23% : Sour Orange 15%. A high incidence of gummosis in some of the imported American budded stock (M.P. M.B6) has been due to budding too low, with the result that affection has begun in the scion and worked down to the stock. The Nigerian practice is to bud the stock at 18" from the ground; to plant in loose earth slightly above ground level so that on consolidation the crown roots are raised from the ground; to fork the scion at not less than 48" from the ground to avoid blanketing of the trunk by overhanging branches.

185. Seeds of Lake Tangelo and Samson Tangelo were brought back for trial at Asuansi. Both have grown and fruited well at Moor Plantation, Samson being more prone to scab than Lake. A third variety of Tangelo, Thornton, planted with the other varieties in 1935, has made good growth but has not yet fruited. Other introductions which will be worth making later are Limonia poggei, as yet only in the seedling stage, and a strain of Nigerian Green Orange which is believed to be resistant to gummosis.

Sugar /

SUGAR.

186. The Nigerian sugar-industry is of particular interest to us, since we have been repeatedly asked in the Press and elsewhere why, if Nigeria can produce sugar at 3d. per lb., we cannot follow suit.

187. Experiments were made in the Gold Coast at Abakrampa, a fairly big cane growing-area, at the beginning of 1941. By using double rollers and a simple process of defecation it was found easy to make crystal sugar. The wholesale price of cane was then 1d. per stick of about 5 lbs., the retail price in the neighbouring town of Cape Coast being about 3 lbs. per penny. 1 lb. of crystal sugar and 1 lb. of molasses were produced from 24 lbs. of cane. The control price of Tate cube sugar was then 5d. per lb., so that the cost of the cane needed to produce 2 lb. of brown crystals was itself as high as that of 1 lb. of refined sugar.

188. The process of sugar making was demonstrated to large numbers of people at Tafo and Kumasi : there has, as far as is known, been no production. An ox-driven triple roller of the Nigerian type was installed in the Keta district in 1942. Sugar could not be made economically, the price of cane rocketing to 2 lb. per penny as the demand increased. It was concluded that a small-scale industry could not be profitable so long as there was a large unsatisfied demand for chewing-stick.

189. The Nigerian sugar industry has been described by Watson (Farm & Forest, June 1942, p.92). A few ox or horse-driven mills of Indian type (Kirloskar Kumar) had been operated by the C.M.S. in Zaria Province during the 1914-18 war. A large number of crushers has been imported from 1941 onwards, and it is estimated that there are now 160 crushers, with an annual output of 2,000 tons of sugar, in operation.

190. The preparation is simple. The juice is boiled down in 44-gallon drums cut along their length and mounted in swish fireplaces. It is continually stirred and skimmed and when of the correct density it is ladled into tin cash bowls of various sizes, where it sets into cakes of a fine-grained candy (gur). This is the form in which the sugar comes on the market. It is hygroscopic, and can be handled easily only in a dry climate. Unless kept in a sealed container it becomes sticky and liable to mould in the South.

191. Goodban (Farm & Forest, December 1944 p.185) carefully studied the economics of sugar crushing in the Maigana district in the 1944 season and showed that at prevalent prices a profit of £5 could be made in producing one ton of sugar at 3d. per lb., allowing £6 per annum

depreciation /

depreciation on the cost (£36) of plant : the average production per crusher was 8 tons per annum. It might be expected either that cane is much cheaper in Nigeria than in the Gold Coast or that the yield of sugar is higher.

192. Neither is the case. Near Maigana crushers were buying cane in the field at £1. 7s. 9d. per ton or 7 lbs. per penny. The retail price of cane in Zaria Province was ½d. to 1d. per stick and a handsome profit could be made by railing (at 7/- per ton) to Jos where the selling price was 1d. to 2d. per stick. Goodban records that towards the end of the 1944 season many operators abandoned crushing in favour of the fresh-cane trade. Army requirements of sugar at 3d. per lb. could not be fulfilled in 1945 since local retail prices were at least 4d. per lb. I paid 1d. each, or upwards of 6d. per lb., direct to a crusher at Funtua for 3" cakes weighing a little over 2 oz. Zaria sugar railed to Kano is retailed at upwards of 9d. per lb.

193. Goodban gives the yield of slab-sugar as 1 lb. per 11½ lb. cane. This is almost identical with our Abakrampa yield, where 1 lb. of molasses-plus-sugar was obtained from 12 lbs. cane. Crystal sugar has been made on a small scale in Nigeria by the use of centrifugals. Juice bought from crushers at the equivalent of 3d. per lb. of sugar yielded two parts of molasses to one of crystals, and no profit could be made unless the sugar were sold for 6d. - 6½d. per lb. and the molasses for 5d. per lb.

194. The present Gold Coast control prices are :- Tate Cube 7d. : Congo crystal 6½d. : South African crystal 5d. per lb. Landed cost of Tate Cube pre-war was 1½d. per lb. duty free. It is clear, as we have repeatedly held, that a local sugar industry cannot hope to compete with estates in the production of crystal sugar.

195. Slab-sugar is, however, not a competitor with crystal sugar. It is in rivalry as a sweetmeat with chewing-stick and as such is reaching a community to whom sugar would otherwise have been unknown. How large this community is may be judged from the fact that pre-war imports of sugar into Nigeria (9,000 tons per annum) were little greater than those of the Gold Coast with a population one-fifth of Nigeria's.

196. The waiting-list for crushers is a long one, and a rapid expansion in production is prophesied when further supplies are available. The impetus to cane-growing has been remarkable, the additional area of crop corresponding to sugar production being in the neighbourhood of 4,000 acres (6 tons per acre). Although it may have taken an entirely unforeseen course there is no doubt that the sugar-industry will prove amongst the more lasting and successful of Nigeria's war efforts.

197. /

197. There is, however, no reason to believe that a similar scheme would have made any headway in our own Northern Territories, where the amount of dry-season farming land (Sadama) is extremely limited and cane prices are as high as 1d. per lb. Sugar is not an essential constituent of diet, and there are many more useful crops to which spare land, if any, might be devoted. The demand for sweetmeats can, when conditions are normal, be met again by the import of boiled sweets or by the local manufacture of sweets from imported sugar.

Addendum.(Natal papers please copy).

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EDITORIAL - GOLD COAST "SPECTATOR DAILY"
FEBRUARY 12TH, 1946.

198. But the country has now a worse experience; Congo sugar seems to have been withdrawn from the market and replaced by another granulated sugar, called Natal sugar which is today in large supply in the country. It has dark brown colour; very much sandy and tasteless. A small pinch of it in a quantity of water is sufficient to tinge the water brown. Perhaps the crudest process is used in producing the commodity. It is unfit for human consumption. The people should not be helped to stake their life on it. The Natal sugar should be withdrawn in the interest of the health of the people. Anything should not be considered good for the people.

SOYA BEANS.

199. Like ourselves the Nigerian Department has devoted a deal of attention to soya beans since 1942 ; like our own the results have been very variable, according to the variety grown and the time of planting. Under favourable conditions yields, as in the Gold Coast, have ranged from about 500 to 1,000 lb. per acre.

200. A large number of varieties has been under test. 33 varieties were tried at Moor Plantation in 1944, the highest yielder bring Trinidad, at 560 lb. per acre. A notable omission from the list is the black-seeded Fort Lamy, which has given the most consistently high yields in the Gold Coast forest belt.

201. /

201. Of 34 varieties tested at Samaru in 1944, 16 of the more promising were under trial in 1945. In the North, Trinidad has not been the highest yielder, although it is popular because of its even maturation which allows the crop to be harvested in three pickings. In 1945 it yielded at Samaru only 540 lb. per acre as against 900 lb. from each of the varieties Malaya, Benares, Dixie and Philippine 92X (yields corrected for missing stands : 1 ton farm yard manure per acre). At Ilorin in 1944 relative yields were Benares 615 : Malaya 575 : Trinidad 470 lb. per acre.

202. There have been many experiments in time of planting. The best results have been obtained when seed has matured in the dry season, considerable loss by mould being obtained if the plants ripen in the rains. In Ibadan early planting leads to loss through insect attack, and early August is thought the best planting time. Some varieties (particularly Trinidad and Benares) rapidly lose viability if stored through the rains, and the planting of an early crop for seed purposes has been recommended.

203. Losses through mould are apt to be particularly high if plants are harvested by cutting at ground level just before ripening and stored until the pods dry out. This practice had been recommended in South Africa to reduce labour costs, and losses due to self-shelling. It has been found impracticable at Yandev and Maigana with varieties which ripen in the rains. At Ilorin cutlassed plants contained a high proportion of immature seed, and although the costs of picking and threshing were 1.9 times greater than those of cutlassing and threshing the yields from picking were 36 per cent. greater than from cutlassing.

204. At Ilorin 12" x 36" spacing has given significantly higher yields than 18" x 36", but at Ibadan no significant difference was obtained between spacings ranging from 6" to 24" on 3' ridges. There are apparently no records of the effect of spacing on hay yields.

205. Propaganda to popularize the beans has been carried out at a number of places. The flavour is said to be more acceptable than that of cowpeas, but even after boiling 4 hours the beans do not mash as easily as cowpeas. The most popular recipes so far evolved are :- Zonkwa : Soak overnight. Boil 3 hours, drain, add guinea-corn, palm-oil and salt, reboil one hour. Ibadan : Soak overnight, remove testa, grind together one measure of soya and two measures of maize, add seasoning, wrap in leaves and boil.

206. The period of cooking needed to make the beans tender is likely to restrict their use in the many places where firewood is at a premium. A similar problem arises in the use of dried pigeon peas. This appears to have been solved by Mr. Asolo of Samaru by the invocation of

the /

the magic tablet of packet peas. He tried two comparative treatments with pigeon peas (a) soaked for 20 minutes in lukewarm water containing a pinch of Kanwa (potash), boiled for 20 minutes (b) boiled for 3 hours. He records that treatment (a) gave delicious tender peas whilst treatment (b) produced tougher peas with a bitter flavour.

207. The use of alkaline softeners is well worth trial with soya beans. The production of bean sprouts which would seem the best use to which the beans can be put, appears to have been demonstrated neither in Nigeria nor the Gold Coast, possibly because of the rapid loss of viability.

C A S S A V A.

208. The production of varieties of cassava resistant to virus disease has been carried out independently in the Gold Coast and Nigeria since 1931. There would be great saving of effort if future work could be more closely standardized, or directed by one person.

209. At Moor Plantation varieties are at present being tested by budding with infected material. None of the resistant varieties so far tested has been found immune to mosaic. The only Gold Coast variety given extensive field trial is 997B (Garri) which has been the best performer at some places (Maigana) and the worst at others (Minna: infection said to be 77 per cent.). Interesting differences in reaction have been observed between North and South. None of the common Northern varieties is affected by virus when grown in the North: when sent to Ibadan in 1932 all showed infection and the average yield per stand was less than 13 lbs. compared with 16-24 lbs. for the Ibadan hybrids. (The commonest Northern variety, dan Warri, whose name suggests a southern origin, was apparently not tested). Conversely all the Ibadan selections have shown mosaic when tried in the North. The vector (Bemisia nigeriensis, Corbert) is common to North and South. It is possible either that resistance may be impaired by change of climate or that different strains of virus exist in North and South.

210. Nigeria has shown less respect than ourselves for the prussic acid content of cassavas, and unboiled and unpeeled roots have been fed to pigs at a number of stations. At Ondo the feeding of cassava from the resistance trial plots appeared to coincide with the death of the entire herd of pigs (para. 127). A large number of deaths due to feeding raw cassava to sheep was reported from Ibadan in February, 1945. We have found dangerous quantities of prussic acid in unboiled samples of some of our resistant hybrids, whereas the local varieties are usually safe.

211. /

211. Experiments made in Ibadan in 1942 showed that at the prevailing price of cassava, 4d. per cwt., cassava starch could be profitably made (woman labour 5d. per day) to meet the demand for export at £14 per ton f.o.b. (£12. 3/- Lagos). In the Gold Coast the cost of cassava was then 1/- per cwt. and the cost of making cassava starch was found to be 1.8d. per lb. The retail price was 3d. per lb. and only trial lots were made for export. Nigerian production of starch was 223 tons in 1941-42 and 5,262 tons in 1942-43, the bulk of production coming from Warri Province. Exports were discontinued in May 1943.

## MISCELLANEOUS.

### B I L T O N G.

212. The United Africa Company Limited has established a factory for the manufacture of biltong from beef and goat-flesh in Kano. The output in 1944-45 was 169 tons beef biltong and 135 tons goat biltong, of which 288 tons were sold to the Army and 16 tons to civilians. Carcases are boned, stripped of skin and fat and cut into long narrow strips which are rolled in salt and cayenne pepper and hung up to dry in a large airy shed. Drying takes three to four days in the dry season and six to seven days in the rains. The average loss on drying is 66% for beef and 60% for goat-flesh. The average bullock gives 2 cwt. boned wet meat or 75 lbs. biltong. (1 ton Biltong = 30 bullocks). The industry should serve a very useful purpose in supplying animal protein to areas where the biltong can be marketed without risk of deterioration. Messrs. United Africa Company Limited give the landed cost Accra as 1/3d. per lb; they supply a pamphlet describing methods of cooking.

### DRIED BLOOD.

213. Reference has been made to the excellent results obtained by the inclusion of animal protein, in the form of dried blood, in the diet of pigs and cattle.

214. The production of dried blood was, at the suggestion of the Agricultural Department, undertaken by the Veterinary and Health Departments in Kano in February, 1944. A very complete account of the process has been given by Dr. E.C. Gilles (Farm and Forest VI.2. p.60 (1945)).

215. Animals to be slaughtered are arranged with their heads in a circle around the drainage slope leading to the blood sump. Slaughtering, by cutting the throat, begins at a signal when all the animals are in position (6.0 to 7.0 a.m.). Carcases may not be washed with water until the blood has been collected in the sump and its entry channel sealed.

216. /

216. The blood is boiled down, with constant stirring, in double walled containers made by riveting a 44-gallon oil-drum inside a slightly larger drum. The boilders are set in a clay fireplace, clayed to within 9" of their top and fired by town refuse, corn stalks and (if the refuse supply is short) coal. The blood is first boiled to the consistency and colour of boiled liver. It then fries in its own fat (110-115°C) to a granular mass which is spread on a drying floor where it is broken by a rake-handle into small lumps. It dries to a non-odorous black lustrous material which is then broken down in a mortar. It is marketed in produce (cocoa) bags of about 180 lbs. at £9 per ton.

217. There are in Kano a 4-boiler unit which serves the City Abattoir, where about 90 cattle and 24 sheep and goats are slaughtered daily, and a single boiler unit which deals with the blood from the 12 cattle and 24 sheep and pigs which are killed daily in the Sabongari market. The total output, from 100-120 gallons of blood per day, is about 5 tons dried blood per month. The production during April-September, 1945, was 26 tons.

218. There is an obvious need for controlled feeding trials of dried blood to pigs in the Gold Coast in view of the apparently normal weight increases which have been obtained without the use of animal protein (p. 130). It is doubtful whether any abattoir in the Gold Coast can supply quantities of blood commensurate with those of the Kano slaughter houses. In the Northern Territories every ounce of blood is eagerly seized and consumed by the people; and anyone who has put his nose over the blood-boilers, and has at the same time a fondness for haggis or other black puddings, will enquire whether surplus blood, if any, should be diverted from human to cattle consumption. Material is, however, available for experiment. The Kumasi abattoir, with a daily kill of 12 beasts and 40 sheep and goats, could supply a single boiler unit similar to that of Sabongari, Kano, and the authorities promise co-operation with the Department.

BONE ASH.

219. Bone-ash is made at the City Abattoir in Kano. The largest bones are left behind, and their fat-content makes them readily inflammable. They are fired together with horns etc., by guinea corn stalks; boiled bones from the town refuse are added when the fire is well started. The calcined bones are then pounded in mortars, repeatedly screened and repounded. The ash is marketed in salt-bags at £9 per ton. The output during April-September, 1945 was 10 tons, a quantity in excess of the requirements of the Department's stock farms. By grinding in a hammer-mill it will probably be possible to bring down the cost of production to a figure at which the ash may be profitably used as a manure.

220. /

GRAIN STORAGE.

220. The normal price for grain in Kano is 0.6d. per lb. at harvest and 0.8d. to 1.0d. per lb. during the rest of the year. In 1943 hoarding by middlemen after a light harvest led to serious inflation: guinea corn rose from 6/11d. per cwt. in January to 25/- in July. Grain stores were erected by the Native Administration with the object of stabilising prices by the release of grain at the time of scarcity (June-July); thus ensuring that farmers should not be scared into corn-growing at the expense of the groundnut crop.

221. Fifteen sheds, each holding 250 tons of bagged grain, were built alongside the Kano railway siding at a cost of £200 each. Grain was hurriedly bought in Maiduguri, but transport by circuitous means more than trebled the cost price, and the Kano landed price was £14. 2/- per ton. It became heavily infested with weevil and was sold at £3.10/- per ton. Since its inception the storage scheme has involved the Native Administration in a loss of £20,000 exclusive of the cost of buildings.

222. In 1944 grain was bought at Katsina at £5 per ton, and cost £7.11/- delivered to store, including bags and staff expenses. At the time of my visit 840 tons of old grain remained in store. It was being sold to licensed market retailers at 16/- per bag (bag worth 1/- to 1/6d.) or about £8 per ton. The maximum daily release was fixed at 10 tons; actual buyings were between 4 and 8 tons. Weevil damage in a sample inspected was about 10 per cent.

223. The sheds had been patched in readiness for fumigation of the new crop, of which 2,000 tons of millet and guinea corn were to be bought. The Senior Entomologist had pointed out the difficulty of making a rectangular building proof against re-infestation, and cylindrical tanks with a domed roof had been designed for new storage centres at Adamawa, Jos and Gusau. Fumigation would be carried out by pouring a non-inflammable mixture of carbon tetrachloride and ethylene dichloride through an opening in the roof leading to a system of evaporating gutters fixed above the grain. The Public Works Department considered that the erection of cylindrical tanks was beyond the capabilities of local workers in ferro-concrete, and the final shape of the buildings had not been decided when I left Nigeria.

OIL EXPRESSION: /

OIL EXPRESSION : SOAP MAKING.

224. The fatuity of re-importing part of our export of oils in the form of common soap was perhaps most apparent in the early days of the war, when valuable shipping space was used in supplying us with a commodity which Great Britain could ill spare and which we could make by the import of caustic soda taking up one-twentieth of the volume occupied by oil and soap together.

225. The small-scale preparation of soap by the cold-drawn process, using coconut or palm-kernel oils with or without the admixture of other oils, was practised in the Gold Coast before the war and has increased considerably during the war years. The practice was officially frowned on, since both copra and palm-kernels were amongst the most urgent of war-time needs. But exports have had to wait on local requirements. The Gold Coast exported 2,541 tons of copra at £9.17.3d. per ton in 1936: locally made coconut oil was then 7/6d. per 4 gallon tin. Despite propaganda for copra production, and a large interim increase in the area under bearing coconuts, exports of copra in 1944 were 841 tons at a controlled price of £10.12.6d. per ton, the price of coconut oil then being £1. per tin in production centres. The fall in copra exports is explained by the equation :- 1 tin oil (20/-) = 300 nuts = 100 lbs. copra (9/6d).

226. A strong plea for the erection of an oil expression plant in the Gold Coast was made by some of us at a time when the chances of being able to ship the cocoa-crop were small. It was thought that the plant could be kept permanently occupied in post-war years in extracting cocoa butter from the increasing percentage of low-grade cocoa which tightened grading regulations would render unexportable. If such a plant had been provided it could have supplied cocoa-butter, coconut and palm-kernels oils at a cost far below that of the laborious local methods; it would have had an efficiency of 90-95% in contrast to the wasteful 50-70% of local methods; it would have given us press-cakes of value as stock-feed, whereas the native methods yield unusable residues in the case of cocoa and palm-kernels, and a product with too high a fat/protein ratio in the case of coconuts (poonac). It was not provided.

227. I was interested to meet in Kano Mr. Georges Calil, whose application to erect an expression plant in the Gold Coast in early 1945 had been refused on the grounds that oil-seeds were still a war priority and that a large expression plant would compete with local industries. The Department had recommended the application for the reasons outlined in the previous paragraph. Whilst soap-making is a local industry worth promoting

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there is little to be said for the encouragement of the extraction of oils by wasteful and tedious local methods; our experience during the campaign for extracting cocoa-butter from unexportable cocoa was that oil-making was regarded as drudgery countenanced only for the purpose of obtaining soap. The first act of many of our departed trainees at Iafo was to write to enquire where they could buy cocoa-butter.

228. Mr. Calil was using an expeller press with groundnuts and obtaining a yield of 34 per cent. of high class salad oil (F.F.A. 0.25% with fresh nuts; rising to 3.0% in nuts stored till July) by single expression; a further 10 per cent. of second grade oil was obtained by repressing the first cake. His price for first grade oil was 30/- per 4 gallon tin and for press-cake £7 per ton. The plant had a capacity of 2,000 tons of nuts per annum, and extra plant with a like capacity was on order; his milling quota for the year was only 40 tons for military use. Mr. Calil was resigned to the restriction on milling but resented that the Departments' requirement of groundnut cake should have to be met by imports from French Territory (Maradi) where similar restrictions had apparently not been imposed.

229. Mr. Sabiston and I had a stimulating discussion with Mr. Calil. We heard the old arguments (para. 91) in favour of retaining press-cakes in the country; we heard new ones. It was suggested that groundnut cake of good quality could be used to remedy the protein deficiency known to exist in the people of the Eastern Provinces. Mr. Calil considered that the expression of oil-seeds in the country of origin was economically sound; first because oil and press-cake together took up less space than the seeds; secondly because oil and cake could be despatched direct to independent markets. Under the present system double transport was often needed; France, for instance, consumed oil and exported cake whilst Britain exported oil and consumed cake.

230. In Kano I also met Mr. Mengouissoglou who operates a soap factory. He had been kept busy altering his formulae to find a substitute for coconut oil which was then 24/- per tin or £75 per ton. The Nigerian coconut industry is smaller than our own, and exports of copra during the war years were not more than 300 tons per annum. Mr. Mengouissoglou said that before the war he had paid £42 per ton for locally made oil, and had found it cheaper to import from Ceylon (present control price ex-British mills £49. 0s. 0d. per ton). Permission to

express /

express palm-kernels had apparently been granted to the Apapa Soap Works (Messrs. Unilever) and press-cake at £2.10/- per ton ex factory has been of great help to the Nigerian Department and ourselves.

PROCESSING MACHINERY.

231. One of the more striking differences between Nigeria and the Gold Coast is the extent to which the two countries have been mechanised. Whereas the smallest southern Gold Coast town has at least one power-driven corn-mill which performs operations, such as the grinding of palm kernels and cocoa prior to oil-extraction, which would surprise its makers, Nigeria still expects its womenfolk to spend their days pounding in mortars and grinding on stones.

The most glaring failure to appreciate this difference was our anachronistic introduction of an ox-driven sugar-mill to Keta in 1942. This mill functioned after the oxen had been duly procured and trained: it could have given a very good immediate performance if suitably harnessed to the many engines waiting for it.

232. When the Nigerian Department in 1941 started milling wheat grown under irrigation in the North, a flour mill was erected in Kano; the management was handed over to the Lissabi Mills Ltd. I paid a most interesting visit to the Lissabi Mills Lagos, with the proprietor, Mr. J.K. Ladipo, a former member of the Nigerian Department. The mill was then engaged in milling wheat, maize, rice, coffee and cocoa and in marketing flours, wheat flakes, mixed cereals and cocoa powder. A large number of the machines, including flour-driers, coffee-roasters and bottle-driers, had not only been designed by Mr. Ladipo but had been assembled with great ingenuity from such scrap material as had been available during the war-years. I would sincerely recommend a visit to these mills by all who claim that the African is lacking in initiative.

ACKNOWLEDGMENTS.

233. I am conscious that this report contains many lacunae; that it is tedious in parts interesting to myself and sketchy in many parts which may be of interest to others. With the subject of Agricultural Education, which has lately been investigated by a number of visiting bodies, I have not dealt. I was impressed by the work of the Oyo Farm School, and recommend the report contained in "Africa Advancing" (Friendship Press, New York, 1945).

234. In Appendix I. I have indicated the sources from which my information was derived, and I am assured that Nigerian officers would be glad to correspond with interested members of our own Department. To the persons named in the Appendix I tender my best thanks for their information and help.

DAB.

## APPENDIX I.

## I T I N E R A R Y.

| | | |
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| November | 21st | Arrive Agege from Cotonou. |
| " | 22nd | Agege Stock Fattening Scheme, Citrus, Cocoa and Grass plots on Agege Station with Mr. H.O. Otuka, Agricultural Assistant. Arrive Ibadan. |
| " | 23rd | Discussions with Mr. A.G. Beattie, Director of Agriculture, Grass plots and Dairy, Moor Plantation. |
| " | 24th | Discussions with J.D. Brown, Deputy Director, Mr. F.L. Buckley, Acting Assistant Director and Dr. H. Vine, Acting Senior Chemist. Visit Agricultural Show, Oyo. |
| " | 26th | Experimental Plots and Unit Farms, Moor Plantation, with Mr. P.H. Richards, Agricultural Officer. Discussions with Mr. G.K.G. Campbell, Botanist. Visit to Citrus Plots. |
| " | 27th | With Dr. Vine and Mr. Campbell to I.N.A. Cocoa Farm and to Swollen Shoot outbreak at Oda-Ona. |
| " | 28th | Ibadan to Jebba via Ilorin Farm. |
| " | 29th | Jebba to Bida. |
| " | 30th | Bida Farm, Badeggi Rice Mill; Rope, twine and mat makers Badeggi and Bida, with Mallam Chadu. |
| December | 1st | Bida to Minna. Minna Piggeries with Mr. R. Turner, Agricultural Officer. Minna to Zaria. |
| " | 2nd | Arrive Samuru. Visits to Dairy and Piggery with Mr. I.E. James, Assistant Director. |
| " | 3rd | Samuru Farm with Mr. T.N. Greeves, Agricultural Officer; Chemical and Botanical Laboratories, Botanist's Plots with Mr. W.E. Freeman, Acting Senior Botanist. |
| " | 4th | Shika Stock Farm with Mr. R.D. Ross, Acting Principal Agricultural Officer, and Mr. T.E. Ryall, Agricultural Officer; Anti-erosion work, Shika, with Mr. G.Browne, Agricultural Engineer. |
| " | 5th | Daudawa Farm and N.A. Settlement Scheme; Sugar-making at Funtua with Assistant Director and Mr. J.W. Goodban, Agricultural Officer. |
| " | 6th | Maigana Farm with Mr. Freeman. |

December 7th /

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| December | 7th | Zaria to Kano. Unit Farms with Mr. D.B. Sabiston, Senior Agricultural Officer. |
| " | 8th | Animal Health Department; Dried Blood and Bone ash making with Mr. A.W.Hart, Veterinary Officer. |
| " | 9th | Night-soil compost pits with Dr. Saxton, Medical Officer of Health. |
| " | 10th | Menguissoglou soap factory and Star-weed plots. |
| " | 11th | Kalil oil-expression plant; Grain Storage sheds: Biltong factory with Mr. Sabiston. |
| " | 11-13th | Kano to Ibadan. |
| " | 14th | Discussions with Mr. K.T. Hartley, Senior Chemist, and Dr. Vine. |
| " | 15-16th | Ibadan to O.P.R.S. via Akure. |
| " | 17th | Experimental Plots O.P.R.S. with Mr.F.W.Toovey Senior Botanist, and Mr. A.C. Trueblood, Botanist. |
| " | 18th | Germinators and Nurseries O.P.R.S. Pollinations at Ogba Farm, Benin City with Mr. Toovey. |
| " | 19th | O.P.R.S. to Ondo. |
| " | 20th | Owena Farm with Mr. A.F.W. Sheffield, Agricultural Officer and Mr. F.E. Decker, Assistant Entomologist, W.A.C.R.I. |
| " | 21st | Ondo to Ibadan. |
| " | 22-24th | Collection data from Departmental Reports. |
| " | 25th | Rotations and Manurial Trials, Moor Plantation with Mr. Hartley and Dr. Vine. |
| " | 26th | Swollen Shoot outbreaks Fashade and Badeku with Mr. T.A. Russell, Agricultural Officer, Cocoa Survey. |
| " | 27th | Ibadan to Lagos. Visit Lagos Dairy, interview Mr. F.E.V. Smith, Development Secretary. |
| " | 28th | Discussions with Mr. E. McL. Watson, Chief Marketing Officer; and Miss M.E.Broughton, Marketing Officer. |
| " | 29th | Visit Lissabi Mills (Mr. J.K. Ladipo). |
| " | 30th | Leave Lagos for Cotonou. |

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