1952-53 [Cmd. 8971] **Colonial Office. Colonial research, 1952-1953. Reports of the Colonial Research Council, Colonial Products Research Council, Colonial Social Science Research Council, Colonial Medical Research Committee, Committee for Colonial Agricultural, Animal Health and Forestry Research, Colonial Insecticides Committee, Colonial Economic Research Committee, Tsetse Fly and Trypanosomiasis Research Committee, Colonial Fisheries Advisory Committee, director, Anti-Locust Research Centre**

COLONIAL OFFICE

COLONIAL RESEARCH 1952—1953

REPORTS OF THE

Colonial Research Council
Colonial Products Research Council
Colonial Social Science Research Council
Colonial Medical Research Committee
Committee for Colonial Agricultural, Animal Health and Forestry Research
Colonial Insecticides Committee
Colonial Economic Research Committee
Tsetse Fly and Trypanosomiasis Research Committee
Colonial Fisheries Advisory Committee
Director, Anti-Locust Research Centre

Presented by the Secretary of State for the Colonies to Parliament by Command of Her Majesty
October 1953

LONDON
HER MAJESTY'S STATIONERY OFFICE
PRICE 7*s* 6*d* NET
Cmd. 8971

REPORTS IN THIS VOLUME

(Each Report is preceded by a full list of Contents)

Colonial Research Council Annual Report on Colonial Research 1952-1953

Colonial Office,
The Church House,
Great Smith Street,
Westminster, S.W.1
22nd July, 1953.

SIR,

As Chairman of the Colonial Research Council, I have the honour to transmit to you the Council's Annual Report on Colonial Research for the year 1952–53.

I have the honour to be,
Sir,
Your obedient servant,
(sgd.) MUNSTER.

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL RESEARCH COUNCIL

Membership

THE PARLIAMENTARY UNDER-SECRETARY OF STATE FOR THE COLONIES (*Chairman*).

THE DEPUTY UNDER-SECRETARY OF STATE IN CHARGE OF ECONOMIC AFFAIRS (*Vice-Chairman*).

DR. W. J. HALL, C.M.G., M.C. (Chairman, Colonial Insecticides, Fungicides and Herbicides Committee).

PROFESSOR SIR DAVID HUGHES-PARRY, M.A., LL.D., D.C.L. (Chairman, Colonial Social Science Research Council).

THE RT. HON. LORD HANKEY, G.C.B., G.C.M.G., G.C.V.O., F.R.S. (Chairman, Colonial Products Research Council).

SIR HAROLD HIMSWORTH, K.C.B., M.D., F.R.C.P. (Chairman, Colonial Medical Research Committee).

SIR BEN LOCKSPEISER, K.C.B., D.Sc., M.I.Mech.E., F.R.Ae.S., F.R.S. (Department of Scientific and Industrial Research).

PROFESSOR SIR ARNOLD PLANT (Chairman, Colonial Economic Research Committee).

SIR EDWARD SALISBURY, C.B.E., D.Sc., F.R.S. (Secretary, The Royal Society).

SIR JOHN SIMONSEN, D.Sc., F.R.S. (Director of Colonial Products Research).

DR. NORMAN WRIGHT, M.A., F.R.I.C. (Chairman, Committee for Colonial Agricultural, Animal Health and Forestry Research).

MR. C. E. LAMBERT, C.M.G. (*Secretary*).

Terms of Reference

The terms of reference of the Council are to advise the Secretary of State for the Colonies on general questions relating to research policy in the Colonial Empire or for its benefit; to co-ordinate the work of the various committees which at present advise the Secretary of State on special aspects of research; and to tender advice to the Secretary of State on research matters not falling within the province of any of these committees.

COLONIAL RESEARCH COUNCIL

ANNUAL REPORT OF COLONIAL RESEARCH FOR 1952–1953

CONTENTS

The following fields of research are dealt with in the accompanying separate reports:—

Agriculture, Animal Health and Forestry.

Colonial Products.

Economic.

Fisheries.

Insecticides.

Locust Research and Control.

Medical.

Social Science.

Tsetse and Trypanosomiasis.

COLONIAL RESEARCH COUNCIL

(1952-1953)

INTRODUCTORY

1. As in previous years, the report of the Council deals with research not covered by the reports of the specialist advisory research committees which are annexed to it. The subjects comprised in the latter are Agriculture, Animal Health and Forestry ; Economic ; Fisheries ; Insecticides, Herbicides and Fungicides ; Anti-Locust research and Locust Control ; Medical ; Colonial Products : Social Science ; and Tsetse and Trypanosomiasis research.

2. Sir John Simonsen's period of appointment lapsed during the year on his retirement from the Directorship of Colonial Products Research.

3. The Chairman visited the West Indies during the year.

4. Reference was made in last year's report to the concern with which Council noted the increasing difficulties arising from the uncertainty regarding the provision of further Colonial Development and Welfare funds after the present Acts expire in 1956. The Council were glad to note from the Minister of State's announcement in Parliament on the 17th July, 1952, that Her Majesty's Government recognise that the need which gave rise to the present Colonial development and welfare arrangements will well exist after 1956 and that they will in good time consider in the light of past experience how the continuing need can best be met ; and that in the House of Lords on the 18th November, 1952, the Parliamentary Under-Secretary of State for the Colonies gave an assurance that the need to provide continuity of funds for research will not be overlooked.

5. The Council are glad to note that in addition to visits to East and West Africa by members of the Colonial Medical Research Committee, members of the Committee for Colonial Agricultural, Animal Health and Forestry Research visited the East African Agriculture and Forestry Research Organisation and the East African Veterinary Research Organisation, and attended meetings of local technical and advisory bodies. They are also interested to know that a member of the Colonial Social Science Research Council and a member of the Colonial Economic Research Committee together made a visit to the West Indies Institute of Social and Economic Research.

I. GENERAL

Colonial Development and Welfare Research Schemes made in 1952–53 *and their cost*

6. A list of the schemes made during the year and the grant allotted to each from Colonial Development and Welfare funds is given in Table I of Appendix I. Fifty-six new schemes and 54 supplementary schemes were made, involving grants totalling £1,087,041. (These compare with 36 new and 53 supplementary schemes made during the previous year entailing grants totalling £868,851). As will be seen from Table II, these grants bring the total sum allotted to Colonial Development and Welfare Research schemes since 1940 to over £12,200,000. From this last figure must, however, be deducted some £1,000,000 arising from unspent balances on completed schemes, revision of schemes, etc., so that the net expenditure and commitment on the 31st March, 1953, was of the order of £11,200,000, of

which some £11,000,000 is chargeable against the funds provided under the 1945 and 1950 Colonial Development and Welfare Acts. The financing of many of these schemes is assisted by Colonial Governments from their own resources. It is estimated that the additional assistance provided in cash or in kind by Colonial Governments or industry since 1940 can be represented by a figure of the order of £3 million. Table III shows the actual disbursements made each year since 1940–41, which now total approximately £6¾ million.

7. About 32·8 per cent. of the gross allocation of £12,200,000 has been for agricultural, animal health and forestry schemes, 14.2 per cent. for medical research, 12·9 per cent. for fisheries research, 10·6 per cent. for tsetse and trypanosomiasis research, 9 per cent. for social science and economic research, 7·5 per cent. for insecticides research, 5·1 per cent. for research sponsored by the Colonial Products Research Council, 3·4 per cent. for anti-locust research, and 4·5 per cent. for miscellaneous schemes including building and road research. Approximately 39·0 per cent. of the gross allocation has been for schemes to benefit the East African territories, 18·4 per cent. for the West African group, 10·2 per cent. for the South-East Asian territories and Hong Kong, 8·2 per cent. for the West Indian Colonies, British Guiana and British Honduras, 6·7 per cent. for the Central African territories (Northern Rhodesia and Nyasaland) and 17·7 per cent. for other territories and for schemes of general interest.

8. The new schemes made during the year include: in Malaya, investigations to assist reclamation of degraded soils and waste land; a scheme for the treatment and control of filariasis; and studies in differences of visual perception among tribes; in East Africa an investigation into soil fertility problems; control of crop pests; control of *stomoxys calcitrans;* and an investigation into condition of liver impairment due to malnutrition; in West Africa timber borer reasearch; investigation into Cameroons Development Corporation labour forces; establishment of an Economic Research Unit, University College, Gold Coast; and assistance towards the completion of a study of the Tiv peoples; in the High Commission Territories, a scheme was made for the appointment of a soil fertility officer to undertake research work; in Fiji schemes for research into animal nutrition, botanical investigations and investigations into plant diseases; in the West Indies, an investigation by the University College into the measurement of capital investment under Colonial conditions; investigation into infestation of rice by the padi bug; and the relationship between plankton distribution and the presence of flying fish. Supplementary schemes include provision for the continuation in East Africa of assistance to the East African inter-territorial research organisations and the Insecticides Research Unit; experiments in the application of insecticides from fixed-wing aircraft; substantial supplementary financial provision has also been made for the agricultural research and experimental station in Nyasaland; further assistance has been granted to the Fisheries Research Organisation serving Northern Rhodesia and Nyasaland; in West Africa, further provision has been made for research into the incidence of maize rust, maintenance of the Medical Research Council's Field Research Station in the Gambia, sociological research in the Gold Coast and in Sierra Leone, rice research, research into the incidence of Loiasis, research on guinea worm, investigation into transport economics in Nigeria; further provision has also been made for research into the control of leaf scald disease of sugar cane, the Ecological Land Use Survey in British Honduras, and, malaria research and the work of the Colonial Microbiological Research Institute in Trinidad.

Colonial Research Service

9. The adoption for the Colonial Research Service of the revised salary scales for the grades of Principal Scientific Officer and above introduced in the United Kingdom Civil Service has now been agreed by all the Colonial Governments concerned.

10. The application of further revised scales introduced in the United Kingdom Scientific Civil Service for the grades of Senior Scientific Officer and Scientific Officer has also been agreed by most Colonial Governments. Proposals have been put to the Malayan Governments and to the Governments of the Gold Coast and Nigeria for the application to the Colonial Research Service of recent revisions of salaries made in these territories.

Research Appointments

11. Twenty-nine appointments were made during the year under review.

Colonial Research Fellowships and Studentships

12. One Fellowship in agriculture was awarded during the year. Thirteen Studentships were granted of which one was in ecology, four for fisheries research, one for medical research, one for veterinary research, five for agriculture and one for stored products.

Scientific Council for Africa South of the Sahara ("C.S.A.")

13. The third full meeting of the Council took place at Costermansville in August last year and work in many of the fields of science of importance to the development of Africa was reviewed. The Council reported that valuable progress was already being made in some of them. The Council confirmed the opinions expressed at the second meeting that the establishment of an organisation for the promotion of collaboration in geological work was of very high importance, and recommended that steps should be taken by the Committee for Technical Co-operation in Africa South of the Sahara (C.C.T.A.) to set up such an organisation as early as possible. The Council also thought that the inter-African aspects of fauna research required to be more strongly emphasised, and decided that the project for fauna research be referred to a specialist meeting, and that any revisions of the existing proposals should be sent to the C.C.T.A. for approval in principle.

14. With the agreement of the participating Governments the Secretary-General visited the United States in the early part of 1953 to establish contact with American scientists and scientific organisations, and to undertake a lecture tour.

15. One of the United Kingdom and Colonial representatives on the Council, Sir Alexander Carr-Saunders, F.B.A., has resigned his membership owing to pressure of other duties.

16. Publication No. 2 of C.S.A., which contains the first report of the Council's activities, covering the period from November, 1950, to June, 1952, was published in August, 1952.

17. A proposal to integrate the Secretariats of C.S.A. and C.C.T.A. was considered without a decision being reached. It is now expected that the Secretariat of C.S.A. will shortly move from Muguga to Buku (Costermansville).

Co-operation between Colonial Governments and the Department of Scientific and Industrial Research

18. The progress made in the fields of building, road and water pollution research is recorded in the second part of this report. At the invitation of the Government of Nigeria, Dr. W. H. Glanville, Director, Road Research Laboratory Department of Scientific and Industrial Research, visited the Territory during the year to advise on road problems.

Assistance provided by the United States Mutual Security Agency (formerly Economic Co-operation Administration)

19. Professor J. C. Matthysse of Cornell University completed his one year's investigation in Northern Rhodesia into means of controlling the tick vectors of various protozoal diseases which affect livestock in Africa.

20. Professor M. Stelly, University of Georgia, was engaged to undertake in Kenya an investigation, lasting about one year, into problems of soil fertility.

21. A further project recently approved by the Mutual Security Agency concerns investigations in West and Central Africa into pasture production and management, and the nutritive qualities of various species of grass and other locally produced feeds. It is hoped to obtain two American scientists for this work in the near future.

Colonial Research Publications

22. In addition to the many reports listed in the reports of the specialist advisory committees, the following reports were published by Her Majesty's Stationery Office during the year under review.

Colonial Research Publication Series:

Land Registration, by Dowson and Sheppard. (Publication No. 13, 25s.)

Women of the Grassfields. The role of women in the economy of the Bamenda, by Phillis Kaberry. (Publication No. 14, 32s. 6d.)

Report on Friendly Societies in the West Indies, by A. F. and D. Wells. (Publication No. 15, 7s. 6d.)

Colonial Research Studies Series:

No. 6. An Annotated Bibliography on Land Tenure. (21s.)

No. 7. The Administration of Justice and the Urban Africa, by A. L. Epstein. (7s. 6d.)

II. RESEARCH MATTERS NOT COVERED BY THE ACCOMPANYING REPORTS OF THE SPECIALIST ADVISORY BODIES

A. *African Administration (including Local Government, Land Tenure and Native Law)*

23. The African Studies Branch of the Colonial Office continued to carry out research into problems of African administration and provided comparative material on a number of questions. In the period under review, major research has been done on land policy and land tenure problems and memoranda on these subjects were produced for Colonial Governments, departments of the Colonial Office, the conference on Central African Federation and the East African Royal Commission of which Mr. R. S. Hudson, C.M.G., Head of the Branch, is a member.

24. Information in the Branch is kept as up to date as possible through regular contact with Colonial Service Officers and sociological workers on leave from Africa.

25. Digests were made of all reports and legislation on local government, native law and courts and land tenure for publication in the *Journal of African Administration* which is edited in, and produced quarterly by the Branch.

26. *Land Tenure.* Mr. S. R. Simpson, C.B.E., lately Registrar General and Commissioner of Lands in the Sudan, was attached to the Branch in April, 1953, to study and advise both the Colonial Office and African Governments on the tenurial aspects of land problems. For this purpose he is arranging for the collection and collation of information both by studying that already available and by visiting the African territories.

27. A special supplement on land tenure was issued with the October, 1952, number of the *Journal of African Administration.* It aimed at stimulating thought by Administrative and Technical Officers in the field in Africa upon the many problems relating to land tenure and land usage.

28. *Local Government.* Mr. C. A. G. Wallis, Senior Research Officer in the Branch, visited Uganda to report and advise the Uganda Government on the system of local government there.

29. The Local Government Advisory Panel gave advice to many Colonial Governments on new and amending local government legislation. The Panel's Finance Committee continued to review the problems of financing local authorities in Africa.

30. *Native Law.* Arising out of a recommendation of the Native Law Advisory Panel, a conference of Judicial and Native Courts Advisers was held at Kampala in February, 1953. The legal, judicial and administrative officers who attended exchanged views and experience on a wide variety of important common problems relating to Native Law and Native Courts in Africa. The report of this conference is to be published as a special supplement to the *Journal of African Administration.*

B. *Building Research*

31. In October, 1952, the Colonial Development and Welfare scheme under which a Colonial Liaison Organisation was established at the Department of Scientific and Industrial Research's Building Research Station was amended. Under the new scheme, the duties and status of the Colonial Liaison Officer, Mr. G. A. Atkinson, B.A.(Arch.), A.R.I.B.A., were revised and his responsibilities were extended to cover advice on housing generally as well as building research matters. In recognition of the new duties Mr. Atkinson was appointed Housing Adviser to the Colonial Office as well as Colonial Liaison Officer, Building Research Station, Department of Scientific and Industrial Research.

32. From 23rd October, 1952, to 20th March, 1953, Mr. Atkinson made an extensive tour of East Africa, India and Malaya. He also visited Mauritius, and attended—as leader of the delegation from the British African territories —an African Regional Housing Research Conference held in Pretoria under the auspices of the Commission for Technical Co-operation in Africa South of the Sahara. The tour had a threefold purpose:

(1) To attend the C.C.T.A. Housing Research Conference, and to discuss and study housing policies and problems in East Africa ;

(2) To attend, as a guest consultant, a symposium on building research in South and South East Asia organised jointly by U.N.E.S.C.O. Science Co-operation Office for South Asia, and the National Institute of Sciences of India ;

(3) To study and report on housing in the Federation of Malaya—in particular that of junior government servants.

The visit to Malaya was made at the request of the Federation Government, and at its expense ; the visit to India was at the request of, and financed by, U.N.E.S.C.O.

33. During the tour, illustrated lectures were given to local architects, civil engineers, etc. The lectures were well attended and were followed by lively discussions. Mr. Atkinson also attended annual meetings of local architectural societies in East Africa, Mauritius, and Singapore. The general impression gained was that the Colonial Liaison Organisation at Building Research Station was becoming widely known, and that there are increasing demands for its assistance and publications, demands far in excess of its present strength.

34. The main object of the far too brief visits made to Uganda before the Pretoria Conference, and to Tanganyika, Zanzibar and Kenya after the Conference, was to discuss African housing practices and policies. In all territories, there has been considerable Government activity in the housing field since Mr. Atkinson's previous visit (in 1949) ; technical and administrative experience has increased and all Governments were, to a varying degree, reviewing present practices. The informal meeting held at Pretoria immediately after the C.C.T.A. Conference enabled delegates from West and Central Africa as well as from East Africa to exchange experiences over a wide field. Mr. Atkinson presided over a meeting and prepared a summary of the discussions which has been circulated by the Secretary of State for the Colonies to African territories.

35. The C.C.T.A. Housing Research Conference, held in Pretoria from 17th to 21st November, 1952, was attended by delegations from the Belgian Congo, French African Territories, East Africa, Southern Rhodesia and British African Territories. The larger part of the papers prepared in advance were from the South African National Building Research Institute, at present the only building research organisation actively at work in Africa. However, discussions between delegates revealed that plans for the extension of building research bodies by British West Africa, French African territories and the Belgian Congo were well under way. It also showed that a certain amount of research was taking place at Materials Laboratories in Kenya and Southern Rhodesia.

36. The Conference proceedings were divided into five sections, each being plenary. Section I dealt with the planning of communities, the main emphasis being on economic and social effects of varying densities of development. Sections II and III dealt with house planning, and considerations of health in housing. A most interesting contribution was made by the South African Building Research Institute on thermal behaviour of small structures ; it was generally agreed that the work should be extended to climates other than that of the uplands of South Africa. Delegations emphasised the need for more studies of existing conditions, particularly to ventilation rates and air temperatures in occupied African housing. Section IV dealt with materials and methods of construction ; here, as was to be expected, the main emphasis in discussion turned to the use of earth, generally stabilised with cement, as a building material. Section V dealt with the economics of building.

37. At the Plenary Session a number of resolutions and recommendations to participating governments were made ; they included arrangements for an inter-territorial committee, consisting of representatives from all participating governments, with a secretariat to be maintained for a period of three years by each government in turn, the object of the committee being to make recommendations for the exchange of information, visits by expert groups, seminars, etc. Certain problems on which further co-operation was most desirable were specified ; they included the more complete documentation of existing standards of housing in different African territories ; further studies of the design of dwellings in relation to climate ; a general study of rural housing problems ; further studies on sanitation ; and on building in earth and earth admixtures.

38. The U.N.E.S.C.O.-National Institute of Sciences of India Symposium on building research in South and South East Asia took place from 21st to 24th December, 1952, at the India National Physical Laboratory, New Delhi ; approximately the same subjects were discussed as at Pretoria. About 150 architects, engineers and scientists from India, Burma, Ceylon and Indonesia attended ; Mr. Atkinson served as joint consultant to the Symposium with the professor of civil engineering, University of Indonesia, and one of the senior professors, the Hebrew Institute of Technology, Haifa. After the Symposium Mr. Atkinson visited Jaipur, Hyderabad (Deccan) and Calcutta, inspecting new housing projects, etc., he also visited the Hyderabad Engineering Research Laboratory.

39. As already mentioned, the main object of Mr. Atkinson's visit to Malaya was to report to the Federation Government on the housing of officers in Division II and lower divisions of the local Civil Service. The report was a continuation of a previous study made in 1952 on the housing of Division I officers. An extensive tour was made of the Federation—the nine States and two Settlements being visited at least once. The report, which makes a number of important recommendations on housing policy and finance, and the standard and design of houses, was presented to the Federation Government before Mr. Atkinson's departure from Malaya.

40. While in Malaya, detailed proposals for a regional building research organisation put forward after Mr. Atkinson's visit in 1952 were discussed at an inter-territorial meeting convened by the Commissioner-General's Office. Recommendations were made, and an allocation of costs was provisionally agreed. The proposals include the formation of a Building Research Advisory Board, with representatives from the various territories and authorities concerned, served by a full-time Technical Secretary. It was recommended that the Technical Secretary should be an architect or civil engineer with experience of research or technical information work and, preferably, with experience in the tropics ; he would be assisted by a small subordinate staff. His first duty would be to investigate various local problems and to prepare appreciations for the Advisory Board, with recommendations for their investigation. He would at the same time organise and operate a technical information service by means of which research work and technical developments throughout the world would be studied and applied to Malayan conditions ; he would also be responsible for studying and recording Malayan practice and experience, and making new developments in different parts of the region more widely known.

41. The Colonial Building Research Liaison Organisation has continued to receive many enquiries from Government departments and architects, civil engineers and commercial firms in the Colonial territories, as well as from individuals and organisations in the U.K. with interests overseas. During

Mr. Atkinson's tour, these enquiries were dealt with by other sections of the Building Research Station. Among the enquiries were requests for advice on the suitability of local aggregates from the Military Authorities in Cyprus and, from the Director of Antiquities, Cyprus, on the improvement of "Terras" used for protecting the stone vaults of the Island's ancient monuments; discussions with Anglo-Iranian Oil Co. Ltd. and their contractors on housing in Aden; and a survey of the practicability of introducing prefabricated buildings for Malayan schools, made at the request of the Colonial Office.

42. Interest in the use in the tropics of prefabricated systems of house construction, exported from the United Kingdom, has been stimulated by a display of designs for "Houses for Export" at the Housing Centre and, subsequently, by the exhibition of demonstration houses at the British Industries Fair, 1953. An article reviewing the use of prefabricated houses in the tropics was prepared for the Housing Centre Review. The probable demand for houses was discussed in terms of three types: the medium-sized (1,000–2,000 sq. ft.) European-type house; the low-cost (200–600 sq. ft.) house for local-born families; the temporary shelter for development work in the field. The demand in tropical countries for European-type houses, such as those being exported to Australia, was thought likely to be relatively small, as they seemed to be at least as expensive as equivalent building in traditional local materials, though they might well be found useful for development projects when speed was of paramount importance. The biggest demand was undoubtedly for simple, cheap constructions, but in this field local prefabrication might well be more than competitive. Over a long term, the most important market in the tropics—particularly in the British territories—was, probably, in equipment for use in local factories producing materials and components rather than in the direct export of buildings. It is hoped to prepare, as a Colonial Building Note, a review of the systems available and to make suggestions on standards suitable for use in tropical countries.

43. Earlier investigations carried out by the Building Research Station for the Uganda Government on raw materials for cement manufacture have borne fruit. Official Bulletin No. 41 (Uganda Protectorate) states: "With the opening of the Cement Works at Tororo on 21st February, 1953, a new chapter in the development of the Protectorate began. The manufactory marks the beginning of what promises to be a series of large-scale industries in Uganda which may change quite radically the economy of the Protectorate. . . . Experiments were carried out mainly at the Building Research Station at Watford, where it was proved that if the rock were calcined, hydrated and then air-separated, a material with low phosphate could be produced".

44. Some 850 copies of each issue of "Colonial Building Notes" are now being published; they are distributed to Government departments, architects, builders, civil engineers and others interested in building in Colonial territories and in other tropical areas. Since last year's report, five further issues have been published; they include two issues on the effect of hurricanes on buildings, based on information obtained after the Jamaica hurricane in 1951 and the Fiji hurricane in 1952. Other issues dealt with the construction of stabilised earth walls; recent literature on school construction in the tropics; types of warm climate and their effect on building design. Mr. Atkinson acted as guest editor for a special number of the United Nations Housing and Town and Country Planning Bulletin (Bulletin No. 6, 1952) on tropical housing. Reprints of his papers on design and construction in the tropics,

and aided self-help housing—its application to the housing of tropical peoples —have been distributed to his Correspondents and other interested.

45. Twenty-one architects and civil engineers, nominated by Colonial Governments, attended a short course organised by the Colonial Liaison Officer at the Building Research Station from 8th to 12th September, 1952. The course was followed by three days spent in visits to other research establishments, including the Forest Products Research Laboratory; and to building and housing work just completed or in the course of erection. A further course is being organised for the autumn of 1953.

C. *Colonial Products Advisory Bureau*

46. The report on the activities of the Bureau during the year under review is annexed as Appendix II. The work of the Colonial Products Research Council and of the Bureau was brought under a common Directorship at the beginning of 1953.

D. *Geodetic and Topographic Surveys*

47. During the year under review the recruitment of field staff did not keep pace with the resignations or transfers. The four American surveyors on loan under E.C.A. agreements completed their tours of duty, and three R.E. Officers seconded have returned to Corps duties. In the drawing offices, the position has been much improved and as a result of the Open Competition held in September, 1952, the total complement of staff is in post. Approval has been received for an increase of 30 additional drawing office staff for the year 1953–54, and prospects of recruitment of field surveyors and other technical staff are much better. It is anticipated that the total staff will be increased by over 50 during 1953–54.

48. The chain of geodetic triangulation connecting the Uganda and Tanganyika systems through Kenya was completed during the year. Computations have shown satisfactory closures. A party of three surveyors worked on the chain running through Nyasaland until November, 1952, when work was closed down with the arrival of the wet season. Progress was much better than in the previous year in spite of persistent bad weather. The observation of this chain should be completed during 1953. The Basutoland triangulation has continued through the year when weather conditions have allowed travel in the mountains, and is now nearing completion.

49. The priority area for photo control has been the Volta river area in the Gold Coast, where a party of six Directorate surveyors with an average of 12 Gold Coast African surveyors has worked throughout the year. The survey now nears completion. A party has been at work throughout the year in Northern Rhodesia completing control in the Western Concession area, and then going on to control mapping for the Kafue Gorge hydroelectric scheme. In November, 1952, a party of two surveyors started work on observing astro fixes in the north of Bechuanaland. In the West Indies work in British Guiana was closed down and the party with the addition of two more surveyors put to work in Barbados and Grenada. One surveyor has continued in St. Vincent during the year. No. 82 Squadron R.A.F. photographed areas in Uganda, Kenya, Basutoland, Tanganyika and Rhodesia until the Squadron was withdrawn to the United Kingdom in September, 1952. No. 683 Squadron R.A.F. continued photography in Somaliland and Aden. A programme of air photography is now being carried out on a commercial contract in British Guiana, Jamaica and the Leeward Islands.

50. Mapping has been continued throughout the year. Priorities have changed even more rapidly than heretofore and larger areas have been

involved. This fact and the impact of National Service on the Cartographic staff have had an adverse effect on map production. Preliminary Plots have been published at scale 1:50,000 covering areas in Uganda, Kenya, Tanganyika, Northern Rhodesia, Basutoland, Swaziland, Somaliland, Gold Coast and North Borneo. A start has been made in the production of Preliminary Plots at 1: 125,000 in desert and semi-desert country, where there is little significant topographical detail to plot, and the first sheets, of Somaliland, have been issued. A series of multicoloured maps was prepared to illustrate the Report on Central African Rail Link Development Survey, June, 1952. Revised editions have been issued of the Antigua 1: 25,000 and the first of the Jamaica 1: 50,000 series. The first two sheets of the new Malaya programme have been plotted. Mapping is in hand of large areas in Kenya (for administrative purposes), Tanganyika (red locust control and resettlement), Northern Rhodesia (hydro-electric and copper belt), Nyasaland (general development), Basutoland (anti-erosion and general development), Nigeria (general development), Gold Coast (hydro-electric) and Sarawak, British Guiana and the West Indian Islands (general development).

51. Cartographic work for the Directorate of Colonial Geological Surveys has increased ; maps, overlays and annotations of air photographs and rough mosaics have been provided.

52. Small scale mapping has been continued of the Falkland Islands Dependencies and a large number of miscellaneous maps, diagrams, etc., have been produced for special purposes.

E. *Geological Surveys*

53. The overseas scientific staff of the Colonial Geological Surveys numbered 190 on the 31st December, 1952, 17 additional geologists and chemists having been appointed during the year in British Guiana, Cyprus, Kenya, the Federation of Malaya, Nigeria, Northern Rhodesia, Sierra Leone, the Somaliland Protectorate, Tanganyika and Uganda. A very useful Economic Co-operation Administration Scheme came to an end which had provided Colonial territories temporarily with additional geological help during the post-war period while the supply of geologists from the United Kingdom and other Commonwealth Universities had been insufficient for our needs. The engagements of the 19 American and Canadian geologists, chemists and mining engineers ended in June, 1952. They had given valuable help for two years while the rapid expansion of Geological Surveys had necessarily resulted in staffs largely composed of officers with limited experience. One Canadian Mining Geologist who had rendered particularly useful service in Tanganyika was re-engaged by that Government to head a team of geologists and mining engineers which will have a special task of stimulating mining development. Each year shows an advance in effectiveness as the young officers who have been appointed during the last five years have grown in experience and confidence, and evidence of this is seen in a larger production of geological maps and publications. To make geological maps of the territories is the first objective of all Colonial Geological Surveys, because the systematic examination of country which is an essential to mapping also enables a selection to be made of those areas where mineral developments may be possible.

54. Some the mineral developments now to be described are the result of geological mapping carried out during the past year, whereas others have been the subject of investigation for many years and have now reached publication stage. In Kenya, graphite deposits were discovered in several

areas and indications were found that the Kakamega goldfield may extend into West Suk. Further work was done on promising kyanite deposits near Sultan Hamud, discovered during the regional survey of that area. More asbestos deposits were discovered in the Teita Hills, and work continued on the establishment of a cement industry at the coast. In Uganda, the Uganda Development Corporation was formed in March, 1952, to take over certain investments made by the Government, including the Tororo cement industry, and to take part with private investors in various development projects. Together with the Rio Tinto Company, Limited, Frobisher, Limited, and Monsanto Chemicals, Limited, the Uganda Development Corporation joined in continuing the exploration of the Sukulu carbonatite mineral complex which till then had been the direct responsibility of the Geological Survey Department. In the North Valley, 2·8 million tons of apatite have been shown present in soil-deposits low in pyrochlore. In other parts it is hoped to mine pyrochlore for its content of niobium, and magnetite may be used to produce iron and steel. The Geological Survey continued its investigations of the wolfram deposits in the Western Province. Of major interest is the immediate future of the Kilembe Mine, in the foothills of the Ruwenzori Mountains, where exploratory work has ended and a start has been made to get the mine ready for production. In Tanganyika, the value of mineral exports during the year 1952 was much higher than in 1951 because the export of diamonds has again been resumed after the settlement of a marketing dispute. Pilot plant production of lead at Mpanda has been satisfactory and a full-scale production plant will eventually be installed. Another lead prospect was discovered elsewhere and is being investigated at depth. A smelting test in Sweden on the Liganga titaniferous iron-ore by the Krupp–Renn process shows the possibility of the production of iron from ore of this type.

55. In Northern Rhodesia a new carbonatite occurrence is in course of examination. Investigation of the coal deposits of the Mid-Zambesi Valley is continuing. Detailed geological mapping is in progress of parts of the Mumbwa District, where copper-gold mineralisation is known. Mica, tin, asbestos and manganese deposits are being examined. The investigation of the carbonatite ring-structures of southern Nyasaland continued, particularly Chilwa Island, Tundulu and Kangankunde, to which attention was drawn mainly as a result of experience gained on the similar complexes of Sukulu and elsewhere in Uganda; here in Nyasaland as in Uganda some of the carbonatites are now known to contain pyrochlore, monazite and other minerals. These recent discoveries of the Colonial Geological Surveys have attracted the interest of mining companies, who are now investigating the deposits. Another ring-structure in Nyasaland contains apatite. A mining company is examining kyanite deposits in Nyasaland. In Bechuanaland, reconnaissance mapping of 2,000 square miles forming an extension of the Waterberg coalfield has indicated the probability of a large area with coals likely to be similar in quality to those of the adjoining Transvaal field where both coking and steam coals occur. There is also another promising coal area north of Palapye. A limited amount of drilling at the old Bushman Copper Mine following last season's geophysical work was sufficient to arouse keen interest on the part of a mining company. Full-scale asbestos mining at Moshaneng near Kanye has been undertaken by a Johannesburg firm. In Swaziland, drilling into the Londosi barytes deposit has indicated probable and potential reserves of 1,070,000 tons. The drilling of a cassiterite-bearing pegmatite has been completed and the results indicate the presence of 30,000 tons of ore carrying 0·37 per cent. metallic tin, valued at £112,000. Ore of this grade is being

profitably mined in South-West Africa. Columbite-bearing gravels prospected by the Geological Survey have attracted the active interest of a mining company.

56. In Nigeria, a new occurrence of several million tons of easily-worked coal has been found near the colliery at Enugu, and much geological work has been carried on in other coal areas. Substantial amounts of deeply-weathered granite carrying about 0·5 lb. per cubic yard of columbite have been found near Jos. In the Gold Coast, some progress has been made in tracing hidden beds of manganese ores in Birrimian rocks and an investigation of fairly large deposits of sillimanite-type minerals is under way. In Sierra Leone, a mining company is undertaking the prospecting of the promising gold-bearing quartz vein mentioned in last year's report. An extensive alluvial ilmenorutile deposit is to be prospected by a mining company as a possible source of niobium.

57. Geological mapping has been resumed in some States of the Federation of Malaya. The mining company which was prospecting for bauxite in West Sarawak suspended its search during the year; there will be a better chance of finding adequate reserves when more progress with geological mapping has been made. In British Guiana, deposits of diamondiferous gravels, of manganese, and of lateritic iron ore have been examined. The Geological Survey of British Honduras is to be continued for a further three years by the Senior Geologist seconded from British Guiana. Much interest in the mineral deposits of Jamaica has been aroused by the investigations of its Geological Survey Department. Additional deposits of bauxite are being sought under a new prospecting licence. An old lead-zinc mine may be re-opened. Companies have shown interest also in deposits of iron-ore and manganese, in dolomite, and in the possible occurrence of oil. The mapping of mineralised areas in Fiji has commenced. The period under review has seen a revival of mining interest in the British Solomon Islands Protectorate.

58. Colonial Geological Survey Departments have continued to assist with engineering schemes, as when large numbers of diamond drill-holes were sited and logged at alternative dam-sites for the Volta Hydro-Electric Scheme in the Gold Coast to afford data from which a final choice could be made. Similarly, detailed mapping of the foreshore enabled a large new port to be sited at Tema, sixteen miles from Accra. Another important task for a Geological Department was the mapping of the sites proposed for the dam and for the tunnel alignment in the projected Kafue Gorge hydro-electric power scheme. In some territories the geological and geophysical investigations necessary for developing underground water supplies are carried out by the Geological Survey Departments, as in Uganda, Nyasaland, Nigeria, Gold Coast, Jamaica and the Leeward Islands; whereas in Kenya, Tanganyika, Northern Rhodesia and Cyprus this work is performed by geologists attached to other departments.

59. The Universities continue to show their interest in the geology and mineral resources of the Colonial territories. Professor W. Q. Kennedy of the University of Leeds was leader of the main expedition of thirteen scientists to the Ruwenzori Mountains in Uganda which took place during three months of 1952. Mr. D. S. Coombs from the Department of Mineralogy and Petrology at Cambridge spent several weeks on Ascension Island mapping the volcanic rocks and collecting specimens of the granitic ejecta which they contain. Dr. M. K. Wells of the University College of London investigated the origin of platinum and allied minerals associated with the noritic complex

of the Colony Peninsula in Sierra Leone. Dr. O. C. Farquhar of the University of Aberdeen examined the ultrabasic rocks of the Teita Hills in Kenya in order to investigate asbestos deposits associated with them. Professor J. H. Taylor of Kings College, London, examined the lead-zinc ore-bodies at the Broken Hill Mine in Northern Rhodesia. A geologist from Hong Kong spent four weeks in North Borneo.

60. During the year the Photogeological Section of the Directorate further continued the reconnaissance mapping in Sarawak and the mapping of a Karroo area in Northern Rhodesia. Much time has been occupied on a study of ring igneous structures in Nyasaland which have potential economic importance because of the associated minerals. What may prove to be similar occurrences have also been detected on air photographs of Tanganyika. A part of the value of such studies in London is that they enable the attention of field geologists to be directed to those localities with the greatest promise of economic return.

61. The work of the Mineral Resources Division of the Directorate, in carrying out investigations on samples of rocks and minerals from Colonial territories, in dealing with technical enquiries concerning the mineral industry generally, and in preparing publications has increased considerably during the year. Short courses of instruction in chemical and spectrographic analyses were given to chemists and geologists from overseas. The Quarterly Bulletin "Colonial Geology and Mineral Resources" is now firmly established.

F. Industrial and Engineering Research

62. In Singapore some investigations have been carried out into: the drainage of Singapore Harbour silt by electric-osmosis; the Cathodic protection of mild steel harbour craft by the use of zinc and aluminium anodes; the use of N. Dakota cone penetrometer in evaluating the stability of road beds and determining economical thickness of road material for a given density of traffic.

63. Investigations by the East African Industrial Research Board include work on: the extraction of Hecogenin from sisal waste; electric smelting of apatite containing pyrochlore with a view to seeing whether niobium metal can be recovered; the manufacture of drain pipes from an alternative clay deposit and non-plastic material; and alternative fuel investigations (the generation of methane gas by the fermentation of vegetable wastes).

64. In Hong Kong an investigation into the factors influencing the properties of concrete made from local materials is in progress.

65. The Crown Agents for the Colonies report that a number of requests were received from Colonial Governments for the services of United Kingdom Consultants to advise on a diversity of Engineering and Architectural schemes, and the Crown Agents' Engineering Advisory Service was intimately connected with these activities and with the Round Table Conference on Colonial Roads held in London during the year under review. Close association with the Colonial Liaison Officers of the Road Research Laboratory and of the Building Research Station was continued, and contact with the Water Pollution Research Laboratory and the Hydraulics Research Laboratory was maintained, technical advice being sought as occasion arose. A considerable number of technical study courses in the United Kingdom, covering a wide range of subjects, were arranged for Colonial Officials at the request of their Governments, and interest in the latest developments in pre-stressed concrete was maintained. Assistance was also given in arranging secondment of Artizan Staff of a Colonial Railway for training in the United Kingdom.

66. The Crown Agents Review included a number of literary contributions, the subject of which had reference to the practical results of research. Among these were a note on the Conference on the Standardization of Mechanical Equipment on Colonial Railways, an article on the tropic proofing of materials and equipment, bearing on the work of the West African Tropical Testing Establishment of the Ministry of Supply, and an article treating of the Research into Colonial Timbers, by the Forest Products Research Laboratory.

G. Meteorology

67. The general shortage of adequately qualified meteorologists and the consequential difficulty of filling staff vacancies as they arise, particularly in West Africa and the British Caribbean area, has meant that most of the Colonial Meteorological Services have been hard pressed to maintain existing forecasting and other services and have had little opportunity for research. The Gold Coast Meteorological Service has, however, produced the paper on *" The climate of the Gold Coast " by Messrs. H. O. Walker and A. D. Swan, and publications of the East African Meteorological Department have included a technical memorandum on †" The trend of rainfall in East Africa " by Dr. H. W. Sansom, and ‡" A note on the weather at Nairobi."

68. The Hong Kong Royal Observatory has produced papers on the upper flow structure near typhoons and the general circulation of the atmosphere over South-East Asia and the Western Pacific, which were published in the Quarterly Journal of the Royal Meteorological Society, and also a paper on analysis of forecasting of the summer weather of the region which appeared in the Journal of Meteorology. Notes on fogs at Waglan Island and on the frequency distribution of summer rain durations at Hong Kong were published locally. Investigations into the effect of strong winds on rain gauge accuracy and ionosphere-weather relationship continue. Evaporation tanks have been installed to enable total water requirements for healthy plant growth to be measured and the results of this research are proving of value for irrigation planning. Seven bases of the Falkland Islands Dependencies Survey were manned throughout the year. The work at all bases included three-hourly meteorological observations. Special forecasts were broadcast for the use of whalers during the season. At Hope Bay sledging parties have continued with topographical and geological survey work. At Signey Island in the South Orkneys a study of the reproductive cycle of the Weddell seal has been made. At other bases studies included ionospheric sounding, tide observations, the collection of snow crystals under varying meteorological conditions and ornithological work. In the United Kingdom the F.I.D. Scientific Bureau has continued to organise the collections for study. Five papers§ have been published.

---

* Gold Coast Meteorological Service. Note No. 1, Accra, 1952.

† East Africa High Commission, Meteorological Department, Technical Memorandum No. 1, 1952.

‡ East Africa High Commission, Meteorological Department. Pamphlet series (2). Rev. 1952.

§ (1) " Organisation and Methods ", by V. E. Fuchs, M.A., Ph.D.

(2) " A New Method of Age Determination in Mammals with special reference to the Elephant Seal (Mirounga leonina, Linn.) ", by R. M. Laws, M.A.

(3) " The Upper Cretaceous Cephalopod Fauna of Graham Land ", by L. F. Spath, D.Sc., F.R.S.

(4) " Lower Cretaceous Gastropoda, Lamellibranchia and Annelida from Alexander I Land (Falkland Islands Dependencies) ", by L. R. Cox, M.A., Sc.D., F.R.S.

(5) " Fossil Penguins from the Mid-Tertiary of Seymour Island ", by B. J. Marples, M.A., M.Sc.

H. Oceanography

69. The National Institute of Oceanography has moved to its new headquarters at Witley, near Godalming, Surrey, which is half-way between London and Portsmouth. The nucleus of its scientific staff is derived from a research group which worked on marine physical problems for the Admiralty, from the scientists employed by the former Discovery Committee and from the Hydrographic Department, Admiralty. All the work, except the care and superintendence of the extensive Discovery Collections, is now centred in the new building. The original intention was to set up a laboratory in London so that the work, which consists of a fair amount of theoretical and experimental work as well as making the most of observations made on different parts of the coast and distant oceans, could be done near laboratories which specialized in all the sciences and techniques that would be used. A suitable building at a rental which the Institute could afford could not, however, be found nearer than Witley, which is something less than one hour by rail from London.

70. The main object is to improve our understanding of marine physics and of the environmental conditions and biological factors which determine the concentrations and fluctuations observed in oceanic fisheries. The marine physicists have again been concentrating on the problems of air-sea energy exchange and its relation to the large and small-scale water movements. They have taken part in recent theoretical advances which give a clearer insight into the part played by the effect of wind and the earth's rotation in determining the major current systems and water circulation, and are making observations at sea and in coastal waters to determine the strength and effect of the forces involved. These include studies of the drag of the wind on the water, the effect of the piling up of the water to leeward or against a coast, and attempts to measure the frictional forces in the body of the water and at the bottom. It is generally agreed that this information is essential to attempts to apply oceanographical knowledge to practical problems in navigation, coastal engineering and the fisheries, but it is a subject which requires long-term research and progress must necessarily be slow till more mathematicians and physicists have been interested in it.

71. Much of the effort in marine biology has had some application to the problems of the life history, distribution and migration of whales. Studies have been made of the statistics of catches, ovaries collected in whale factories and returned whale marks for the purpose of following changes in whale population, but at the same time considerable progress has been made towards improving our understanding of the factors which give rise to the observed distribution and variations in population. Some of these studies, particularly that relating to whale food, give a striking picture of how the successful spawning and growth of a marine animal depends on the presence of a particular environment at each stage of the life history. Studies of the factors which make some parts of the deep ocean more productive than others have been centred round recent and earlier surveys of the regions influenced by the Benguela and Peru currents, where there are very marked contrasts and sharp changes in the water conditions, and some results have been published.

72. The Institute has not yet grown to such a size that it can readily make scientists available to do much towards assisting with special problems in other parts of the world, nor are its workshops sufficiently established to allow some of the useful apparatus which has been developed to be made available in any quantity to others who might be able to use it, but growth will be more rapid in the new premises. Further details are given in the Annual Report 1951-52 issued by the National Oceanographic Council, Cambridge

University Press, 5s., and in the report for 1952-53, which will be published in January, 1954.

I. Road Research

73. In June, 1952, a Round Table Conference on Colonial Highway Problems was held at the Institution of Civil Engineers. This Conference was an informal conference of P.W.D. Engineers following on the Colonial Engineering Conference at the Institution of Civil Engineers at which the Colonial Road Research Liaison Officer (Mr. Pollitt) read a paper entitled "The Need for Colonial Road Research".

74. As a result of the discussions which took place at this Conference and the subsequent consideration of the reports on Mr. Pollitt's visits to the African Colonies by the Colonial Research Council, the Secretary of State for the Colonies agreed that the reports should be examined by an expert body, and a special expert Committee was appointed under the Chairmanship of Dr. Glanville, Director of Road Research with the following terms of reference:—

> "To consider the reports of the Colonial Road Research Liaison Officer on the road research problems of East and Central Africa and to make recommendations to the Colonial Research Council."

This Committee has met and is making a report to the Colonial Research Council.

75. During the year, work on Colonial problems at the Road Research Laboratory has been limited by the lack of staff available for this work. A report has been issued on a method of stabilisation of a black cotton soil from Southern Rhodesia with lime and wood tar. This report has been circulated to a number of Colonies, and it is hoped that a full-scale trial will be carried out in the near future.

76. Information has been received about the movement of moisture in soils under airfields in a number of Colonies, and this is being analysed. This work is continuing.

77. Tests have been carried out on four sands and aggregates from North Borneo to determine their suitability in concrete, and a report has been issued giving recommendations for their use.

78. A note giving recommendations for their manufacture of bituminous sand carpets using a local sand in the Gambia has been issued.

79. Tests are being made on a sample of wattle-tar from Kenya to determine what are likely to be its best uses in the road making field. Tests have also been made on a coal tar from the Wankie Colliery, Northern Rhodesia, and suggestions have been made as to how it can be improved.

80. During the year Mr. Pollitt resigned from the Road Research Laboratory to take up an appointment with the association of Portland Cement Manufacturers, and Mr. F. H. P. Williams was appointed Colonial Road Research Liaison Officer in his place. Mr. Williams visited the South-East Asia territories in April, 1953.

J. Water Pollution

81. The Water Pollution Research Laboratory have assisted the Government of the Falkland Islands with respect to their water supplies: samples were flown to the United Kingdom and analyses and some experiments were carried out by the Laboratory from which they suggested methods for removing colour and reducing corrosion.

82. The Laboratory have advised the Government of the Somaliland Protectorate on the disposal of waste waters from a slaughter house, and have had correspondence with the Government of Malaya on the design of septic tanks.

83. Before he left the United Kingdom to take up appointment in the service of the Government of Uganda, Mr. H. A. Harbottle spent some time at the Laboratory and visited places in the United Kingdom at which pollutional problems were being dealt with.

APPENDIX I

Table I

LIST OF SCHEMES APPROVED FOR RESEARCH GRANTS UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS DURING THE PERIOD 1ST APRIL, 1952, TO 31ST MARCH, 1953

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
97C	General	Appointment of Secretary to the Colonial Social Science Research Council and the Colonial Economic Research Committee. (Supplementary provision.)	6,930
247E	do.	Contribution towards British Commonwealth Scientific Office. (Supplementary provision.)	250
247F			1,000
292A	do.	Provision for award of soil science research studentships. (Supplementary provision.)	5,300
296B	do.	Appointment of Tropical Soils Adviser at Rothamsted Experimental Station. (Supplementary provision.)	5,700
328C	do.	Appointment of Termite Research Officer. (Supplementary provision.)	6,400
331A	do.	Appointment of Statistician and ancillary staff at Rothamsted Experimental Station. (Supplementary provision.)	6,200
356B	do.	Fundamental Insecticide Research at Imperial College of Science, Silwood Park. (Supplementary provision.)	8,100
357B	do.	Fundamental Insecticide Research at Rothamsted Experimental Station. (Supplementary provision.)	8,800
371A	do.	Appointment of Colonial Liaison Officer, Pest Infestation Laboratory, Department of Scientific and Industrial Research. (Supplementary provision.)	5,000
476A	do.	Purchase of rotary brush spraying equipment for use in dissemination of insecticides from aircraft. (Supplementary provision.)	85
494A	do.	Maintenance of Anti-Locust Research Centre and its Extra-mural research. (Supplementary provision.)	31,330

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
497	General	Development of a smoke generator for application of insecticides to dense vegetation.	650
500	do.	Insecticides research. Studies of attractants and repellants at the Imperial College of Science and Technology, Silwood Park.	4,880
502	do.	Employment of Termite Research Officer in United Kingdom. (Continuation of Scheme No. R.328.)	10,000
506	do.	Insecticides research. Studies at Ministry of Supply Experimental Station, Porton, in application of chemicals from the air.	4,000
508	do.	Visit to the United States of America by two insecticides research workers to study American methods of disseminating chemicals from the air.	730
513	do.	Experiments by Colonial Insecticides Research team at Porton in aerial spraying from helicopters.	4,500
528	do.	Contribution towards cost of employment of Colonial Building Research liaison officer and Housing Adviser to the Colonial Office. (See also statement I—Scheme No. D.1870.)	18,000
532	do.	Visits of members of Colonial Agricultural Research Council to Colonial territories.	4,000
537	do.	Visits abroad by members of Colonial Fisheries Advisory Committee.	1,030
545	do.	Colonial Products Research Council. (Continuation of Scheme No. R.7.)	41,600
546	do.	Production of copies of miscellaneous reports and papers by research workers employed under Research Schemes.	600
549	do.	Publication of Monograph on "Ecology of Glossina palpalis".	450
216F	Africa, General	Research into reproductive cycle of African ungulates. (Supplementary provision.)	83
269A	do.	Visit of experts to African territories to survey the sociological, economic, agricultural and technical problems attending the mechanisation of Colonial agriculture. (Supplementary provision.)	93
391A	do.	Research into the history of British Administration in Africa. (Supplementary provision.)	110
519	do.	Assistance towards publication of a monograph on Simuliidae (biting flies) of Africa.	500

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
290A 290B	**East Africa, General**	Insecticides research. Malaria research in collaboration with the East African Insecticides Research Unit. (Supplementary provision.)	910 63
409C 409D 409E 409F	do.	East African Institute of Social and Economic Research. (Supplementary provision.)	1,905 13,167 6,000 8,249
511 511A 511B	do.	Medical Research. Visit of research worker from Bristol University to undertake investigation into condition of liver impairment due to malnutrition.	1,300 140 100
515 516	do.	Experiments in East Africa in the application of insecticides from fixed-wing aircraft.	1,000 11,500
517 517A	do.	Contribution towards cost of visit to East Africa by Mutual Security Agency expert to investigate soil fertility problems.	2,750 850
522	do.	Insecticides Research. Purchase of chemicals for trials in the defoliation of bush in East Africa.	800
523	do.	East African Insecticides Research Unit. (Continuation of Scheme No. R.386.)	90,000
526	do.	East African Fisheries Research Organisation. (Continuation of Scheme No. R.71.)	43,000
527	do.	East African Agriculture and Forestry Research Organisation. (Continuation of Scheme No. R.301.)	173,380
529	do.	East African Bureau of Research in Hygiene and Tropical Medicine. (Continuation of Scheme No. R.244.)	5,842
388A 388B	**Kenya**	Sociological research. (Supplementary provision.)	338 338
530	**Tanganyika**	Insecticides research. Establishment of team for research in control of crop pests.	19,150
550	do.	Appointment of Botanist to Colonial Insecticide Research Unit.	9,000
351B	**Uganda**	Sociological research. (Supplementary provision.)	100
521	do.	Assistance towards cost of visit to Uganda by a member of the Tuberculosis Research Unit, Medical Research Council, to plan trials in the treatment of tuberculosis.	340
534 534A	do.	Fixed wing aircraft experiments in reclamation of tsetse infested area.	14,000 7,800
548	do.	Research into control of Stomoxys calcitrans	19,200

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
518 518A	East and Central Africa	Economic survey of the structure and organisation of the distributing industries of Tanganyika and Nyasaland.	650 100
394A 394B	Central Africa, General	Establishment of a Fisheries Research Organisation to serve Northern Rhodesia and Nyasaland. (Supplementary provision.)	1,669 1,130
157C	Nyasaland	Establishment of Agricultural Research and Experimental Station. (Supplementary provision.)	32,935
332C	West Africa, General	Enquiry into the structure and organisation of trade in West Africa. (Supplementary provision.)	60
471A	do.	Research into incidence of maize rust. (Supplementary provision.)	3,660
498	do.	Assistance towards research by Reader in Anthropology, University of Edinburgh, into West African problems.	70
501	do.	Maintenance of the Medical Research Council's Field Research Station at Fajara, Gambia. (Continuation of Scheme No. R.180.)	106,597
509	do.	Visit of a University student to work at the West African Fisheries Research Station.	175
512	do.	Visit of Director of West African Tsetse and Trypanosomiasis Research Institute to attend West African Inter-Territorial Conference.	210
524 525	do.	Timber borer research in West Africa and United Kingdom.	5,650 2,900
540	do.	Provision of cattle for experiments with Ethidium Bromide.	750
547	do.	Investigation by expert, in association with West African Institute for Economic Research, into Cameroons Development Corporation labour force.	3,500
406A	Gold Coast	Sociological research. (Supplementary provision.)	333
531	do.	Establishment of Economic Research Unit, University College, Gold Coast.	15,000
109B	Nigeria	Hot Climate Physiology unit. (Supplementary provision.)	26,450
322B 322C	do.	Research into the incidence of Loiasis. (Supplementary provision.)	1,700 14,135
397A	do.	Research at University College, Ibadan, Nigeria, on Guinea worm. (Supplementary provision.)	1,530

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
	West Africa		
410B	**Nigeria**	Investigation into transport economics of Nigeria. (Supplementary provision.)	65
426B	do.	Laboratory and field studies by lecturer of University College, London, at the Hot Climate Physiological Research Unit Laboratory. (Supplementary provision.)	450
460A	do.	Investigation of endemic goitre. (Supplementary provision.)	100
496	do.	Assistance towards completion of a study of the Tiv peoples.	450
510	do.	Laboratory and field studies by lecturer of London School of Hygiene and Tropical Medicine at the Hot Climate Physiological Research Unit Laboratory.	480
514	do.	Rice research. (Continuation of Scheme No. R.224.)	43,160
539	do.	Purchase of capital equipment for Uzuakoli Leprosy Settlement.	2,000
341B	**Sierra Leone**	Sociological research. (Supplementary provision.)	220
341C			220
341D			286
495	**South African High Commission Territories**	Appointment of soil fertility officer for research in Basutoland, the Bechuanaland Protectorate and Swaziland.	5,000
312B	**Atlantic, Falkland Islands**	Establishment and maintenance of Falkland Islands Dependencies Survey Scientific Bureau. (Supplementary provision.)	1,750
535	**Mediterranean, Cyprus**	Investigation into disease of broad beans.	1,250
543	**Indian Ocean, Mauritius**	Malaria Eradication. (Continuation of Scheme No. R.227.)	11,100
177F	**South East Asia, Federation of Malaya**	Research into Scrub Typhus. (Supplementary provision.)	2,114
507	do.	Investigations to assist reclamation of degraded soils and waste land in Malaya.	7,040
538	do.	Treatment and control of Filariasis.	12,500
541	do.	Studies in differences of visual perception among tribes in Malaya.	300
372B	**Singapore**	Sociological research. (Supplementary provision.)	286
475B	**North Borneo**	Re-establishment of Herbarium at Sandakan. (Supplementary provision.)	686

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
544	**North Borneo**	Appointment of Soil Scientist. (See also Statement I—Scheme No. D.1939.)	9,760
503	**Western Pacific, Fiji**	Research into animal nutrition at the Agricultural Station, Sigatoka.	17,725
504	do.	Botanical investigations at the Agricultural Station, Sigatoka.	9,253
505	do.	Investigation into plant diseases at the Agricultural Station, Sigatoka.	5,889
533	**Solomon Islands**	Investigation into means of controlling Amblypelta cocophaga, a coconut pest.	6,920
520	**West Indies, General**	Investigation by the University College of the West Indies into the measurement of capital investment under Colonial conditions.	2,500
542	do.	Tour of inspection of West Indies Institute for Social and Economic Research by members of Colonial Social Science Research Council.	665
536	**Barbados**	Research into relationship between plankton distribution and presence of flying fish.	800
454A	**British Guiana**	Research into control of leaf scald disease of sugar cane. (Supplementary provision.)	190
499	do.	Investigation into infestation of rice by the padi bug.	1,100
499A			220
473A	**British Honduras**	Appointment of Experimental Officer to Ecological Land use Survey. (Supplementary provision.) (See also Statement I—Scheme No. D.1807A.)	3,750
350C	**Trinidad**	Malaria research. (Supplementary provision.)	24,000
236F	do.	Continuation of the work of Colonial Microbiological Research Institute. (Supplementary provision.)	77,515
231B	**Leeward and Windward Islands**	Seismic investigation. (Supplementary provision.)	550
		TOTAL	£1,087,041

Table II

ALLOCATIONS FOR RESEARCH UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS, 1940, 1945 AND 1950

Period to	Totals	
	Allocation for period	Cumulative allocation
	£	£
31st October, 1942	57,158	57,158
31st March, 1943	15,340	72,498
31st March, 1944	224,835	297,333
31st March, 1945	116,795	414,128
31st March, 1946	660,776*	1,074,904*
31st March, 1947	1,099,382*	2,174,286*
31st March, 1948	2,073,340*	4,247,626*
31st March, 1949	1,666,229*	5,913,855*
31st March, 1950	1,814,124*	7,727,979*
31st March, 1951	2,514,536*	10,242,515*
31st March, 1952	879,902*	11,122,417*
31st March, 1953	1,096,404*	12,218,821

* These figures include expenditure totalling £136,486 incurred up to the 31st March, 1953, on Scheme R.7 (work of the Colonial Products Research Council: see Appendix II to Progress Report of the Colonial Research Committee for 1942–43, Cmd. 6486).

Table III

ACTUAL ISSUES IN RESPECT OF RESEARCH SCHEMES, 1940–1953

Financial Year	Issues
	£
1940–41	Nil
1941–42	6,670
1942–43	13,793
1943–44	30,450
1944–45	58,345
1945–46	93,307
1946–47	169,388
1947–48	428,301
1948–49	764,211
1949–50	1,285,348
1950–51	1,411,352
1951–52	1,231,445
1952–53	1,267,423
Total	£6,760,033

APPENDIX II

Colonial Products Advisory Bureau Report of the Director for 1952-53

GENERAL

The work undertaken by the Bureau, and that sponsored by the Colonial Products Research Council, have been put under a single direction, as proposed in "Colonial Research" for the previous year, on page 10. The new arrangement commenced on 1st January, 1953, with Dr. R. A. E. Galley, A.R.C.S., D.I.C., F.R.I.C., as Director, and Dr. J. R. Furlong, O.B.E., A.R.I.C., as Deputy Director of Colonial Products Research.

During the year under review 77 laboratory investigations were completed, and the inquiries dealt with amounted to 763.

The recently reconstituted Consultative Committee on Oils and Oilseeds met for the first time in May, 1952, and again in March, 1953, while the newly-formed sub-committees on (1) Groundnuts and (2) Oil Palm, held three meetings.

The meetings of the other Consultative Committees were as follows: Essential Oils (1), Tanning Materials (1), Hides and Skins (1) and Insecticide Sub-Committee on Analysis (2).

The more important investigations and inquiries carried out during the year are summarised in the following section. Some of the reports and papers were published in the quarterly journal of the Bureau—"Colonial Plant and Animal Products," and in other technical journals.

Chemical and Technical Research

VEGETABLE INSECTICIDES

Pyrethrum. Collaborative investigations on the biological activity of extracts, and the storage performance of flowers, of three strains of Kenya pyrethrum (referred to in the report for 1951-52) were continued. Organisations in the United Kingdom and the U.S.A. participated, the test insects used including the housefly (*Musca domestica*), the grain weevil (*Calandria granaria*), the red rust flour beetle (*Tribolium castaneum*) and the mustard beetle (*Chaedon cochleariae*). The assessment of the results is not yet complete, but some preliminary conclusions have emerged. One of the high pyrethrin flower strains appears to be very susceptible to storage, losing about 25 per cent. of its original active content during three months' storage, compared with a loss of only 8 per cent. by another strain stored under similar conditions. There are also indications that the biological activity of extracts prepared from this high content strain after storage of the flowers may be slightly impaired.

Research on the chromatographic separation of the active insecticidal principles of pyrethrum has continued, following the publication, jointly with Rothamsted, of the work described in the 1951-52 report. The object is to develop a simple reproducible method of separation that will facilitate the chemical analysis of pyrethrum, present methods based upon solvent partition being not altogether satisfactory. Promising results have been obtained using purified pyrethrum extracts, and the application of the method to crude extracts is being examined.

Work on the determination of moisture in pyrethrum flowers is in hand. Methods based upon entrainment with solvents and oven drying have been compared in relation to the state of subdivision of the flowers.

The Principal of the Bureau and Dr. Potter of Rothamsted visited East Africa to study outstanding problems of the pyrethrum industry there, including the future research programme and marketing questions. A report has been presented.

ESSENTIAL OILS

Cinnamon Bark Oil from the Seychelles. As a result of previous work on Seychelles cinnamon bark oil, recommendations were made by the Bureau for the modification of the distillation technique used in the Seychelles, with a view to the production of an oil conforming to a standard quality, i.e., containing up to 75 per cent. of cinnamic aldehyde and soluble in 3 volumes of 70 per cent. alcohol. Subsequently, five samples of oil distilled in the Seychelles were examined at the Bureau. From the information supplied, it was apparent that the recommendations made had not been adhered to strictly, and this was confirmed by the results of examination of the oils. As reliable conclusions could not be drawn from the results of analysis of oils which had been produced without the maintenance of rigid control of the method of preparation of the raw material and of the conduct of the distillation at all stages, it will be necessary for a further series of experimenal distillations to be carried out.

Sage from Cyprus. The preliminary examination of the essential oils obtained by steam distillation of the leaves collected from 13 localities in April, June, July, August and September, 1951, has been completed. It was found that, in general, the yield of oil obtained increased progressively with the time of collection, reaching a maximum in September. Examination of the oils indicated that the total ketone content varied considerably (from 3·9 to 57·6 per cent.), and consisted in some cases mainly of d-camphor, in the remainder, mainly of l-camphor. A more detailed examination of the samples is now being made. As the information obtained from the results of examination of the oils made so far was insufficient for definite conclusions to be drawn regarding the best time of the year for collecting the leaves, it was agreed to continue monthly collections, starting in July, 1952, and continuing for a period of 8 to 12 months. The leaves collected so far are now being examined at the Bureau.

Safrole. Recently, inquiries have been directed towards the possibility of obtaining from Colonial territories essential oils rich in safrole, this compound being required as the starting material for the synthesis of piperonyl butoxide for use as a synergist for pyrethrum insecticides. At present, it is obtained for this purpose in the United Kingdom from Brazilian sassafras oil (from *Ocotea cymbarum* or *O. pretiosa*). The annual production of this oil in Brazil is estimated at 490 tons, 90 per cent. of which is exported to the U.S.A., and it seems doubtful whether the remainder, say 50 tons per annum, will in future be sufficient to meet increasing demands outside the U.S.A., especially as that country's own requirements will probably increase. For this reason, and the fact that dollars are required for the Brazilian product, a colonial source of a suitable oil would be welcome. In 1925, two samples of " Medang Losoh " oil, distilled in Malaya from the wood of *Cinnamomum parthenoxylon,* were examined at the Imperial Institute, and were found to consist chiefly of safrole. At that time, heavy camphor oil (from Formosa), which is rich in safrole, was obtainable at very low prices, and it was considered that " Medang Losoh " oil would not be able to compete with the low-priced Formosan product. In 1952, the question of obtaining supplies of *C. parthenoxylon* oil was discussed again with the Director of Forestry, Malaya, but he was of the opinion that, owing to the prevailing emergency conditions there, the collection of material would be fraught with such difficulties as to render it impossible as an economic proposition. It was suggested that inquiries might be made in Sarawak, and North Borneo, where conditions were likely to be more suitable and, recently, the Conservator of Forests, Sarawak, has forwarded samples of the wood of *C. parthenoxylon* and also of *C. iners,* the most common Cinnamomum species in the Colony. These samples are now under examination.

Muhuhu oil from Tanganyika. Muhuhu oil is obtained by steam distillation of waste muhugwe wood, from *Brachylaena hutchinsii,* an important East Africa timber tree. The essential oil is a viscous oil with an odour of cedarwood and vetiver oils. Small quantities were available in London about 15 years ago, but supplies ceased on the outbreak of the last war. In 1952, a sample of muhugwe sawdust and muhuhu oil were received from a firm of sawmillers in Tanganyika.

The sawdust was found to yield about 2 per cent. of oil on steam distillation, but it is not certain that this represents the maximum amount of oil obtainable from the wood. The results of examination of the oil were compared with those obtained at the Imperial Institute for samples of oil of *B. hutchinsii*, prepared by the Agricultural Chemist, Kenya, in 1931, and 1933, in the course of systematic distillation trials on the wood. The sample from Tanganyika was found to be of rather poor quality, its content of esters and of " total alcohols " being somewhat lower than the corresponding values for the Kenya oils, and it was concluded that the distillation had not been sufficiently prolonged. As, however, the oil as received had aroused some interest in the trade, it was felt that a more carefully prepared oil would meet with a more favourable reception. Recommendations were, therefore, made to the producer for improving his method of distillation and further samples of this oil are awaited.

Slash Pine from British Honduras. In consequence of the investigation previously carried out at the Bureau on the oleo-resin obtained from the British Honduras slash pine (*Pinus caribaea*, Morelet or *P. Hondurensis*, Loock), the Consultative Committee on Essential Oils recommended that a trial consignment of one to two tons should be shipped to the United Kingdom for a trial distillation on a commercial scale, although the Committee considered that, ultimately, the oleo-resin should be processed in the Colony. Accordingly, the Department of Forests, British Honduras, arranged for the collection of this quantity of the oleo-resin. Initial results were disappointing, the yield of oleo-resin from the trees being exteremely low, but following modifications in the tapping technique used, yields improved considerably. As a result of this experience, it was decided to extend this trial collection into a study of tapping techniques, in order to discover which method was best suited to the British Honduras slash pine, which differs in certain respects from the slash pine grown in the U.S.A. The work is being continued.

SPICES

Nigerian Black Pepper. Several samples of Nigerian Black Pepper, some submitted by merchants in London, others by the Department of Agriculture, Nigeria, were examined for their suitability as a substitute for true pepper (*Piper nigrum*). It was thought that this spice was already being used in the United Kingdom for seasoning sausages and similar manufactured food products. The samples were believed to be derived from *P. guineense* or *P. clusii* and, with the exception of one which had been specially cleaned, were of poor appearance compared with commercial samples of true black pepper. On examination, they were found to differ from genuine pepper in several respects, but mainly in having a higher oil content, and a lower, somewhat variable piperine content. It was concluded that, if suitably cleaned, spice of this type could be used for seasoning purposes, but could not be marketed as " pepper " or " black pepper ", which are defined officially as the dried fruits of *Piper nigrum*. Recently, samples of true black pepper, obtained from three Indian varieties of the vine, grown in Nigeria, were received from the Department of Agriculture, Nigeria, and are at present under examination.

GUMS AND RESINS

Gum Arabic from Somaliland Protectorate. Following earlier work at the Bureau, during the course of which a large number of samples collected from individual, marked trees, known to the Somalis as " gum adad " were examined, a larger sample was received from Somaliland. On examination, it was found to be comparable with commercial Kordofan and Nigerian gum arabic, except that the viscosity of a 10 per cent. solution in water was somewhat higher, and solutions prepared from it had a darker colour. This sample, however, represented a distinct advance on any of the large number of samples examined previously, and was sufficiently promising to warrant a bulk sample test by a leading firm of confectionery manufacturers in the United Kingdom.

Gum of Sterculia sp. from Kenya. The sample, derived from an unidentified species of *Sterculia* growing in the Colony, after removal of the bulk of the adhering vegetable debris in the laboratory, was found to conform to the requirements of *The British Pharmaceutical Codex,* 1949. Owing to the heavy contamination of the sample with vegetable debris, no opinion on its commercial value could be expressed, but in view of the present importance of Karaya gum in industry, the submission of a further sample, containing the minimum of foreign matter, was advised. In connection with gum from species of *Sterculia,* it is interesting to note that quite recently a subsidiary company of the Clarke-Cleveland Corporation of the U.S.A. was set up in Nyasaland to purchase and export gum from *S. quinqueloba,* which is stated to be equal or superior to Karaya gum. This may be taken to indicate a growing need for gum of this type in dollar areas, and good quality gum of similar properties should, therefore, be of commercial interest.

HIDES AND SKINS

Somaliland Sheepskins. The Mission of United Kingdom tanners, led by the Principal of the Bureau, which visited Somaliland Protectorate in 1949, recommended a new procedure in the drying of sheepskins, in order to overcome the putrefactive damage arising from the imperfect drying by the old method of suspension on four pegs. The improved method employs five pegs, enabling more complete spreading of the skin, and further, provides for the removal of the scrotal portion, with its harmful folds, a portion which is useless to the tanner and discarded in the tannery. Skins from drying trials recently carried out in Somaliland were examined and submitted to tanning trials in the United Kingdom. The results confirm the expectations that the new method provides a perfectly dried skin, and eliminates the risk of putrefaction not only in the belly area, but in the adjoining parts. The removal of the scrotal portion is advantageous, and the new method is considered highly satisfactory in every way.

Goatskins. The investigation of trade complaints concerning certain consignments of Nigerian goat skins was continued, and work was carried out in conjunction with several tanneries in the United Kingdom. The faults were identified as due to the inclusion of skins of inferior origin, and of imperfectly dried skins, during the period when the demand was strong and prices exceptionally high.

Drying of Skins. Work in conjunction with the British Leather Manufacturers' Research Association on sheepskins from trials in the Sudan, proposed and planned by the Bureau, entailing also tannery trials, has indicated that there is a ceiling temperature for the sun-drying of skins.

Further trials have already been carried out in the Sudan on goat and sheep skins, and are now under investigation for the confirmation of the previous result. So far, it has been shown that the suspension drying of skins in the sun without salting, is more satisfactory than dry-salting, subject to a limiting temperature. This should enable the fault associated with salted skins, viz. deterioration of skin substance during storage, to be eliminated.

Conference. A conference on Colonial hides and skins, proposed by the Bureau, was held for the first time in September, 1952 in London, at which officers concerned with the production and improvement of these materials in Colonial territories, United Kingdom tanners, and representatives of merchants and shippers, met, and discussed the problems of the industry. A report has been issued. The results were highly satisfactory, and the holding of further conferences bi-annually, and visits of tanners to Colonial territories were recommended.

The following papers were read at the Conference, and formed the basis for the discussions:—Drying of Hides and Skins (J. R. Furlong); Flaying and after-cleaning (E. Knew); Dry-salting of skins (H. Phillips); Buying systems (M. H. French); Grading and Marking (J. R. Furlong); Port Inspection (M. H. French); Export Cess (J. T. H. Pettit); Hide Improvement Services (R. J. Simmons); Instruction by Films (D. R. Faulkner); Damage from various sources (R. Withinshaw); Branding (J. B. Solomon); Cracking (J. T. H. Pettit); Baling (M. H. French).

PAPER-MAKING MATERIALS

Timber from 28 different species of trees, from Kenya, Malaya and the Gold Coast, have been under examination. The reports will be issued during the coming months. *Albizzia falcata* wood is giving promising results, and the work on this material is nearing completion.

The measurement of the dimensions of the ultimate fibres into which the fibre strands of bast and leaf fibres can be broken down has always constituted a large part of the practical work of the Fibre Section of the Bureau. These measurements are of considerable value from the point of view of paper-making, and also of fibre indentification. The method of preparing ultimate fibres which is given in the literature, and which until recently was used at the Bureau, involves repeated treatments with chlorine followed by sodium sulphite solution. This method is tedious and may degrade the fibre ultimates. A quicker way of separating the ultimates which involves very much less risk of damage to them has recently been devised at the Bureau. This method consists of treating the fibre with a dilute solution of sodium chlorite acidified with acetic acid, followed by shaking the fibre in a polythene bottle containing a number of small rubber-covered glass rods. The superiority of this method has been confirmed by an independent worker in this field, and the improved method has been submitted to The Textile Institute to be considered for inclusion in the 4th edition of "Identification of Textile Materials".

Owing to the fact that tropical forests invariably consist of a number of different species of trees, the possibility of mixing different hardwoods together for digestion purposes is being studied. Up till now insufficient work has been done on this aspect to enable any definite conclusions to be drawn, but in one or two cases the results obtained have been quite satisfactory.

VEGETABLE FIBRES

As last year, the work in the laboratories has proceeded on two main lines, viz. the examination of jute and possible jute substitutes, and other commercially-important fibres, and methods of fibre identification.

Jute. Samples of jute grown in Tanganyika and the Gold Coast, were examined. Among the possible jute substitutes which were examined by the Bureau in co-operation with The British Jute Trade Research Association, were *Hibiscus tiliaceus*, *Pavonia urens*, various samples of *Hibiscus cannabinus* and *Hibiscus kitaibelifolius*. The work has confirmed the results previously obtained that for the finer counts of yarn, jute fibre is practically in a class on its own. The chief faults to be found with the samples examined were that they had not been properly prepared, and in particular that the retting of the fibre was at fault. It is noticeable, however, that, with experience, the preparation of the fibres is being improved, and there seems no reason why with further experience retting should not be carried out satisfactorily in Colonial countries.

Identification of fibres. Work has continued on the compilation of the type collection of fibres. It has been found of considerable value already, as will be shown by the following example. An important firm in this country wished to obtain supplies of a fibre, the diameter of whose ultimates had to be within a very limited range. The Bureau was able to suggest at once three fibres whose ultimates were in the required range, and samples of these were obtained and submitted to the firm for trial. Later on a fourth fibre was suggested which was also found suitable. The Bureau has been in touch with the Colonies from which the fibres were obtained with a view to getting commercial supplies, although one or two practical difficulties with regard to the extraction of the fibres in question remain to be overcome.

Loofahs. During the year, samples of loofahs from Tanganyika, British Honduras, Gambia, Nyasaland, Antigua, St. Kitts and the Gold Coast have been examined and trade reports obtained on them. Some of the samples showed that loofahs almost equal in quality and preparation to the Japanese loofahs which are at present imported into this country can be obtained from Colonial sources.

Unfortunately, however, there are ample supplies of Japanese loofahs on the market at very low prices, and it seems doubtful whether, under present conditions, loofahs from Colonial sources would be able to compete in price. In some countries, Japanese seed has been imported and cultivation trials are still continuing.

For use as a substitute for cork in the manufacture of linoleum, a number of materials have been considered and, one of these, "cork shrub" from Nigeria, the exact botanical identification of which has not yet been ascertained, was found to be suitable for the purpose for which it was required.

In Mauritius, the fibre from *Furcraea gigantea* Vent. is extracted from the leaves by passing them through rollers, some of which are furnished with beater bars. A new type of machine has been devised which was stated to extract the fibre more efficiently, but it was found that the beater bars blunted very quickly. The Bureau has investigated the possibility of employing metals to be used in place of steel to increase the life of the bars. Stainless steel was considered to be too expensive. Samples of the used beater bars were obtained from Mauritius and submitted to a metal research laboratory in this country, who advised that the damage to the bars had been caused mainly by erosion. They suggested that the metal for the bars should be water quenched, and this advice was passed on to the authorities in Mauritius. It is understood that tests made with beater bars treated in this manner have shown that the length of life of the bars has been considerably increased. The tests in Mauritius are still going on.

A proposal to grow Henequen and Sansevieria in British Honduras near the Mexican border, has been examined. Any industry set up would have to be run on peasant lines and would have to be developed as a side-line to the production of staple food crops. The Bureau advised that for various reasons such a proposition would not be practicable, and it was doubtful whether such fibres from British Honduras would be able to compete economically in the world's markets. In view, however, of the proximity of the area to Mexico, which is the world's sole producer of *Agave lecheguilla*, Torr., the fibre of which is used for brush-making, and of which there is no source of supply in the Colonial Empire, it was suggested that it might be worth while carrying out some trials in the cultivation of the plant. The Bureau arranged, therefore, with the Royal Botanic Gardens, Kew, that some specimens of the plant should be shipped to British Honduras so that trials could be made there by the Department of Agriculture.

The following studies, amongst others, have been made: The market for mohair in this country; the economics of *Phormium* production and processing; the progress of schemes for the mechanised production of stem fibres; the nomenclature and definitions for various fibres in connection with standards for the British Standards Institution and for H.M. Customs; the preparation of coir fibre and the machinery available for the extraction of the fibre; and the cultivation of rattans.

TANNING MATERIALS

Continued attention has been given to a survey of materials which occur in the Colonial territories, and which might be developed as sources of tannin.

Mopani bark derived from *Copaifera mopani* from Bechuanaland Protectorate was found to be too low in tannin for the bark to be of value for export, while the production of a solid extract would not be an economic proposition.

The crushed pods of *Parkia filicoidea* contained 25 per cent. tannin. Use of a leach liquor prepared from this material for tanning trials showed that the penetration of the tannin was slow; the resulting leather had a good feel but was of a red colour. The liquor became mouldy and slimy during use. Development of this material depends on supplies and costs involved.

The testa from groundnuts (*Arachis hypogea*) were found to contain 19 per cent. tannin with a ratio of tans to non-tans of 3:1. A solid extract could be prepared from this material containing approximately 60 per cent. tannin. Sample of leather prepared was light coloured and soft and pliable.

The investigation of suitable agents for rendering the iron present in the powdered pods of *Acacia arabica* is being continued.

Attempts are still being made in Nigeria to produce a mangrove extract of suitable quality for the market. A sample examined at the Bureau was found to contain 44 per cent. tannin, somewhat lower than the usual trade sample containing 50–55 per cent. tannin, and also the colour was very high.

OILSEEDS

Groundnuts. Work on this product, the commencement of which was reported last year (see *Annual Report,* para 31) was continued and extended. Studies showed that the kernels from Gambian and Nigerian crops, as lifted by the peasant, have a very satisfactory and extractable protein and oil content. The quality was high, but both crops as marketed in the United Kingdom were well below standard. The cause of the discrepancy in the Gambia, where undecorticated groundnuts are marketed, may have been due in part to faulty sampling technique. The work, therefore, is to be repeated. The discrepancy in Nigeria seems due mainly to the more rapid deterioration suffered by broken kernels, and the high proportion, approximately one-third, of the latter present in the decorticated nuts, the form in which the Nigerian crop is marketed in the United Kingdom.

The question of introducing mechanical decortication on a larger scale in Nigeria is under study. Advice has been given to the authorities there on the selection of commercial machinery, and several decorticators, not only of English but also of French, Indian and American manufacture, are at present under trial. A method of determining extractable protein was elaborated in the Bureau's laboratories, where it was found that mature kernels contained a higher percentage of oil and extractable protein than immature ones grown under the same conditions. A detailed programme of investigational and research work still needed on the ground nut was drawn up for the information of the West African Governments.

Oil palm. In connection with studies of the oil palm at the West African Institute for Oil Palm Research, advice was given on breeding and analytical problems. The difficult question in long-term marketing whether or not to breed a fruit having a negligible amount of kernel was undecided at the end of the year, and is being further considered. In the commercial expression of tung oil in Nyasaland, difficulties in marketing arose due to persistent cloudiness present in the filtered oil. The cause of this was shown to be an isomeric change, and following advice, the trouble has been much reduced.

Cohune nuts from British Honduras were examined in connection with a renewed proposal for their production as an oilseed. A similar project was started in 1929, but the company concerned went into liquidation due partly, it has been alleged, to the lack of a suitable decorticator. In an experimental study 95 per cent. of nuts were broken in a prototype machine, and some uses for the shell have been suggested, but the development of the crop seems yet remote, and is likely to remain so since only one-tenth of the fruit is nut.

Considerable study was given to the question of encouraging Colonial castor seed cultivation, but representations by the trade that this should be done with Government capital were not accepted. Advice was given to West African authorities concerning expression locally of shea nuts. *Licania venosa* and *Moringa oleifera,* minor oilseeds, were also examined during the year.

WAXES

Sugarcane and sisal waxes were both under laboratory study in connection with proposals from Barbados and Kenya respectively to develop them as carnauba substitutes. At the end of the year, improved products from both sources had been received in the laboratory, but the difficult phase of marketing has yet to be investigated.

FOODS AND FEEDINGSTUFFS

Samples of tea from Malaya, and coffee from the Gold Coast, British Honduras and the West Indies were examined as to their market value in the United Kingdom. An increasing interest was displayed by the Colonies in food processing. Where the latter is carried out by the peasant, the end products are usually nutritionally satisfactory, but as soon as larger scale technology is applied there is danger that the products will be less satisfactory. The milling of sorghum, the parboiling of rice and the manufacture of *gari* (a preparation from cassava) were under study during the year. Samples of experimentally-milled sorghum were submitted to the West African authorities, and it was suggested that pilot milling should be tested. In connection with a pilot scheme for the parboiling of rice, owing to low consumer acceptance, it seemed desirable to develop an alternative approach. In investigations on *gari* manufacture, typical samples of a native-prepared product are under examination for the assessment of their nutritional value.

At the request of the Director of Agriculture, Sarawak, discussions were opened with trade users concerning the marketing of sago starch. One firm sent out a small technical mission to study the industry in the Colony. Stricter control by the imposition of standards of quality, adoption of mill marks and a demonstration factory were suggested as possible steps to improve the present production. There are problems of local marketing, however, to be overcome.

Dried blood from Somaliland and ghee from Nigeria were under examination in connection with marketing problems. *Parkia filicoides* pods from West Africa were examined in connection with their possible use in Colonial road stabilisation. Samples examined by the Road Research Laboratory did not indicate any marked stabilising effect on soils, and only small amounts of pectin were present. Several agricultural wastes have been studied, including cocoa shells which were found to be but a poor source of furfural, black pod cocoa as a possible source for cocoa butter, dom palm nuts (*Hyphaene thebaica*) and fan palm nuts (*Borassus flabellifera*) which gave 10·3 per cent. and 12·5 per cent. respectively of furfural. Citrus waste can be processed by pressing and drying, when it makes a suitable feedingstuff.

TOBACCO

Four varieties of air-dried tobacco grown in two districts in Ashanti, Gold Coast, were examined. The varieties concerned were well known and, in other areas, provide leaf suitable for cigarettes. The Gold Coast products were abnormal, and had unattractive flavours. With improved cultural treatment and flue-curing a much better tobacco could be obtained.

A sample of " Krekh " cigarettes from Indonesia were examined and found to contain approximately 25 per cent. by weight of cloves mixed with the tobacco. This industry is one of the main users of Zanzibar cloves in the Far East.

FRUIT

Several studies of a marketing nature have been undertaken. During the recent years of relative scarcity of imported fruits, there has been a limited trade in dried pineapple. A small experimental sample of diced material from Kenya received favourable preliminary commercial comments; it is proposed to follow this up by a fuller investigation with larger samples. Dried pineapple may have long-term possibilities both for retail sale, and for reconstitution and canning in importing countries. Commercial opinions were sought regarding the probable future United Kingdom market for canned pineapple and grapefruit segments and for canned citrus and pineapple juices from Colonial territories. Opinions indicated that the market position may be expected to become more competitive within the next few years, particularly with any freer access to world supplies of canned goods, and that the future of these Colonial fruit products is likely to be determined by the factors of quality and price. For the maintenance of quality, the adoption of grading standards by producers seems essential, while any return to larger sales of canned fruit on a pre-war scale will be dependent on reasonable selling prices. In the long term, a downward price tendency is

anticipated with values falling below present levels. The most favoured varieties of imported canned fruit are expected to be as in former days (i.e. pears, peaches, pineapples, apricots, fruit-salad, grapefruit segments, Japanese mandarin oranges) with, as yet, little popular demand for such packs as guavas, mangoes and papaw. Compared to canned fruits, the consumption of canned fruit juices is limited, although there appears to have been some increase over a period. It seems clear that canned juices will always have to be sold at reasonable rates to find public favour in competition with bottled fruit squashes. Commercial inquiries also indicated that there is a promising United Kingdom market for fresh coconuts from British Honduras, provided exporters can maintain a satisfactory standard of quality. On the other hand, freer supplies of fresh bananas have restricted the always limited outlet for dried banana figs and, at present, production may be in excess of requirements. The position of banana flour is even less encouraging. There is no demand in the United Kingdom, while recent imports into the United States have been of negligible amounts.

SHELLS

Consideration was given to the utilisation of the shell of the conch fish, which is in abundance round the cayes in the waters of British Honduras. Although there are reports that such shells have been employed in the manufacture of pearl buttons, exhaustive trade inquiries in this country disclosed no prospect of their use. Arrangements were made for the shell to be tested by the Cyprus button industry, but without positive results. A commercial trial as material for making plates for studs and links in this country was also negative. The manufacturers reported that this type of conch shell is not only brittle, but is very flaky and easily splits into different layers. Conch shells are used in the production of cameos, but the chief centre for this industry is in Italy. Several Italian manufacturers were approached, and sample shells were submitted, but it seems that Zanzibar conch shell is preferred. One firm evinced a little interest but it appears that transport considerations may preclude any serious commercial development.

Colonial Products Research Council Tenth Annual Report (1952-1953)

Highstead,
Limpsfield,
Surrey.

29th July, 1953.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Products Research Council for the year 1952–53.

I am, Sir,

Your obedient Servant,

(Sgd.) HANKEY.

(Chairman).

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL PRODUCTS RESEARCH COUNCIL

Membership

THE RT. HON. LORD HANKEY, G.C.B., G.C.M.G., G.C.V.O., F.R.S. (*Chairman*).

DR. B. K. BLOUNT, Ph.D., F.R.I.C., Department of Scientific and Industrial Research.

PROFESSOR H. V. A. BRISCOE, D.Sc., F.R.I.C., Imperial College of Science and Technology.

DR. E. E. CHEESMAN, D.Sc., A.R.C.S., Agricultural Research Council.

MR. W. B. L. MONSON, C.M.G., Colonial Office.

PROFESSOR E. R. H. JONES, D.Sc., F.R.I.C., F.R.S., Professor of Organic Chemistry, University of Manchester.

DR. R. A. E. GALLEY, Ph.D., A.R.C.S., D.I.C., F.R.I.C., Director of Research.

DR. H. G. THORNTON, F.R.S., Rothamsted Experimental Station, Harpenden.

PROFESSOR A. R. TODD, M.A., D.Sc., F.R.I.C., F.R.S., Professor of Organic Chemistry, University of Cambridge.

DR. J. WALKER, D.Sc., National Institute for Medical Research.

PROFESSOR E. L. HIRST, M.A., D.Sc., LL.D., F.R.S., Professor of Organic Chemistry, University of Edinburgh.

MR. R. W. PIPER (*Secretary*).

The terms of reference of the Council are:

"To review the field of Colonial production and to advise what Colonial raw materials are likely to be of value to the manufacture of intermediate and other products required by industry; in consultation with the Director, to initiate and supervise researches, both pure and applied, on such products, and generally to consider how by the application of research greater use can be made of them.

In framing their programme the Council will have as their objective the promotion of the welfare and prosperity of Colonial peoples, and will endeavour also to increase the Colonial contribution to the welfare and prosperity of the British Empire and of the world as a whole. The Council will ensure that full use is made of existing research organisations, in particular the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council. In formulating their research policy, they will also call into consultation persons with expert knowledge in science, industry, and other related fields."

COLONIAL PRODUCTS RESEARCH COUNCIL

TENTH ANNUAL REPORT

CONTENTS

COLONIAL PRODUCTS RESEARCH COUNCIL

TENTH ANNUAL REPORT

PART I. GENERAL

1. Staffing matters and progress in general terms are dealt with in this Part I, and attention is drawn to some of the more important developments, while Part II contains a review of the research work in more technical detail.

2. *Changes in the composition of the Council.* Mr. E. Barnard resigned from the Council in May, 1952, and Dr. B. K. Blount was appointed in his place. Mr. C. G. Eastwood resigned in October, 1952, on his appointment as Permanent Commissioner for Crown Lands and was succeeded by Mr. W. B. L. Monson. Dr. R. A. E. Galley was appointed Director of Research and a member of the Council on the retirement of Sir John Simonsen on the 1st January, 1953.

Mr. R. W. Piper was appointed Secretary of the Council in August, 1952, in place of Mr. K. G. Ashton.

Two meetings of the Council were held during the year.

The Council wish to record their appreciation of the valuable services rendered by Sir John Simonsen, who had so ably directed the research carried out under the aegis of the Council since its inception, and by Mr. E. Barnard and Mr. C. G. Eastwood.

3. *The Colonial Microbiological Research Institute.* Dr. A. C. Thaysen, Director, visited the United Kingdom during June, 1952, and discussed various aspects of the Institute's work with specialists in this country.

4. Dr. Forsyth, the Institute's biochemist, while in the United Kingdom on leave spent two months at Glasgow University where, through the courtesy of Professor J. W. Cook, F.R.S., he was able to synthesise various cyanidin compounds for the purpose of testing the specificity of the enzymes of the cacao bean, which play an important part in the fermentation of the raw beans and the development of flavour. He also attended the 2nd International Congress of Biochemistry in Paris in July, 1952.

5. Progress in completing the repairs to the laboratory has been slow but the Pilot Plant has been completed and work in it can soon begin.

6. Consultation of the Institute by industries in the West Indies has continued. Twenty-seven colonies have now appointed liaison officers, and there has been a useful exchange of information with some of them.

7. The Cocoa and Confectionery Alliance of Great Britain have kindly placed at the disposal of the Director of the Institute the sum of £3,000 to facilitate the work being carried out on cocoa fermentation and to enable members of the staff conducting this research to visit other cocoa producing countries and to attend conferences on cocoa research.

8. The Hankey Culture Collection now comprises 547 strains (78 actinomycetes, 106 bacteria, 106 yeasts and 257 fungi). It is proving of great value in supplying scientific institutions and commercial firms with material. Most of the cultures added during the year have been dermatophytes isolated in connection with work on the Institute's antibiotic, corifrin, which has been found so promising in the treatment of fungus skin infections, commonly known as Tinea. Skin scrapings from human and animal infections have also been received for examination from Jamaica and West Africa.

9. In connection with the increasing interest in the micro-organisms in soil the study of the distribution of *Fungi Imperfecti* in Trinidad soils, was continued.

10. Professor L. F. Wiggins, Director of Research, Sugar Technological Laboratory, Trinidad, was able to visit Puerto Rico during the year as a guest of the Puerto Rico Sugar Producers' Association, and to attend their Annual Sugar Technologists' Conference ; he read a paper which was greatly appreciated. Together with Messrs. Williams, Winstanley, Thomson, Schmidt, Yearwood and Dr. Davison he attended the 1951 Meeting of the British West Indies Sugar Technologists in British Guiana, and presented eight papers to that Conference. The Director of Research visited the Universities of Birmingham, London, Cambridge and North Wales. Mr. Winstanley attended a course in paper-making and testing at the Manchester College of Technology.

11. *Antibiotics : Comirin.* The clinical trials on the fungistatic antibiotic comirin, which were mentioned in the previous report, have now been completed. They were carried out under the supervision of Dr. M. A. Fawkes, Medical Superintendent of the Caribbean Medical Centre and Dr. E. C. Richardson, an ear specialist of Port-of-Spain. The application of comirin proved effective. The new preparations of comirin, to enable it to make deeper penetration of the skin tissue, were prepared. Promising results were obtained by Dr. Fawkes for the treatment of various forms of Tinea, although two out of twenty-four cases examined were reported as failures. Considerable attention is being given to these two cases to find an explanation of the reported failures.

12. *Monamycin.* Professor Hassall and his collaborators improved the method of extraction of the antibiotic monamycin and made progress in separating and characterising the different active materials in the monamycin complex. A start was made in determining the chemical constitution of the antibiotic.

13. *The Sugar Technological Laboratory at the Imperial College of Agriculture in Trinidad.* An impressive programme of work was completed during the year. The pilot factory was operated for several weeks, and, during this period, it was possible not only to provide laboratory workers with plant experience, but also to give training to students and to try out various technological devices. Among the last may be mentioned superstats and a new type of filter. Both pieces of apparatus proved disappointing ; no decreased scale formation was noted in the factory with the use of the former, and the value of the results was not sufficient to justify the cost of operating the filter. An attempt was made to apply a household homogenizer to the analysis of bagasse for its residual sugar content, and although the new method was both time-saving and accurate, the machine utilised was not sufficiently robust for routine work. A physical method of estimating aconitic acid in molasses was perfected and applied to samples collected from several West Indian factories. Unfortunately, only two samples were found to be remotely promising, and in no case did the concentration reach the 2 per cent. considered desirable for commercial exploitation. Methods suitable for the large-scale preparation of sugar cane wax were improved, and a survey was completed of the wax contents of the West Indian filter press muds. At the present time these muds are not utilised. The hard waxes obtained by the new process should compete with Carnauba in the preparation of high-grade polishes. Varietal cane studies in the laboratory and pilot factory were completed with a

view to assessing their comparative value to the industry. Paper chromatography applied to plant juices proved extremely successful in separating the amino-acids, the patterns of which from different parts of the plant are similar. The yellow pigment present in cane juice was estimated in different varieties. Further development of these methods may have results of considerable practical importance.

The work on the production of lactic acid and its esters from molasses was continued. Conditions for maximum yield were established and the results were sufficiently promising to justify the installation of a pilot plant.

Itaconic acid can be used in the plastics industry, and laboratory biological studies have shown that by suitable culture of an *Aspergillus* a 20 per cent. yield of the acid (calculated on the sugar) is obtained. Such laboratory methods would be quite unsuitable for large-scale production and, accordingly, attempts were made to apply the techniques used in penicillin manufacture, so far with a 10 per cent. yield. Since sugar can be provided at 3½d. per lb. and the final acid is worth something in the region of 5s. lb., this biological conversion is promising. Further results of this work are awaited with interest by the Council.

Other problems of a less fundamental nature were examined, and from Professor L. F. Wiggins' Report to the Council it is evident that the services of the laboratory were greatly appreciated by sugar producers in the West Indies.

14. *Timber Research.* Further work was undertaken at the Forest Products Research Laboratory on the production of hardboard for building and industrial purposes from secondary Colonial timbers, and attention was directed to reducing as far as possible the consumption of chemicals, nearly all of which have to be imported into the Colonial territories. Hardboard of high strength was obtained but this was associated with low-water resistance. Measures of improving water resistance were developed.

In Professor King's Department in the University of Nottingham, the acid present as a saponin in the timber *makore* has been identified. Another acid, also a triterpenoid acid was isolated from this wood.

15. *The Striga Germination Factor.* Experiments on the part played by this germination stimulant were continued. The isolation of small quantities has been described in previous reports. The technique for the bulk preparation of the crude factor has now been improved and the method of testing stimulatory solutions has been modified.

16. *Carbohydrates.* Progress was made in the research on dextrans. A preparation of dextran is of outstanding importance as a blood plasma substitute. In connexion with the study of the possibilities of developing drugs having anti-allergic actions, dextrans were found to be useful tools. Professor M. Stacey, F.R.S., and his collaborators confirmed by chemical methods that the claim of Dr. E. C. Hehre of New York, based on serological evidence that the polysaccharide produced by the enzyme derived from *Acetobacter capsulatum* is a true dextran, is correct. The structure of other dextrans were also determined. Professor Stacey used glucose labelled with the C^{14} atom for a study of bacterial cellulose prepared from the glucose.

In Professor Peat's laboratory a new micro-method for the determination of molecular weights of maltosaccharides was developed. His work on the starch metabolising enzymes was also continued.

17. *Clove Oil.* Mr. P. Lees, working under the direction of Professor G. R. Clemo, made further studies on the chemistry of eugenol. Some new isoquinoline bases were prepared which are undergoing pharmacological tests by the Medical Research Council. So far, however, no new use for eugenol has been found.

18. *Oils and Fats.* Dr. M. L. Meara and his collaborators completed the examination of the component glycerides of coconut and palm kernel oils which were shown to consist of complex mixtures of mixed glycerides.

Examination of samples of copra obtained by steam processing of the nut showed that the extracted oil was of good colour and very low free fatty acid content.

The characteristics of samples of body fat, gut fat and ovary fat of the locust *Locusta migratoria migratorides* were determined. Fats of similar characteristics were bulked for full qualitative and quantitative analysis.

19. *Conophor Oil* (from *Tetracarpidium conophorum*). Quantities of oil distributed under the supervision of Dr. L. A. Jordan, Director of the Paint Research Station, gave highly satisfactory results in technical trials. The oil, if available commercially, should command a premium over linseed oil.

Professor H. D. Kay of the National Institute for Research in Dairying, found the cake remaining after the oil extraction to be palatable to most cows. There was nothing to suggest that it could not form a good protein concentrate. Reports received from the Western Region Production and Development Board in Nigeria, where a total of 56 acres have been planted, show that cultivation costs may be as much as £100, and that the yield may be as high as 1 ton per acre. It remains to be ascertained whether cultivation can be achieved at a cost that would permit of a product at a competitive level. It is undoubtedly a difficult plant to cultivate, and further reports from the plantation trial are awaited with interest.

The Oilseeds Consultative Committee of the Colonial Products Advisory Bureau have arranged to keep the various agricultural, technical and other aspects under review so that the long-term prospects of conophor as a crop may be accurately assessed.

20. *Miscellaneous.* The examination of a number of plants for products of possible biological value or as starting materials for the fine chemicals industry continued in departments of chemistry in Universities in the United Kingdom. Details of these investigations are given in paragraphs 40–48.

PART II. REVIEW OF RESEARCH WORK IN PROGRESS

Clove Oil [33]

21. Work was continued by Mr. P. Lees working under the direction of Professor G. R. Clemo, on the hydrogenation of eugenol. He also explored the Mannich reaction on eugenol. Mr. Temple prepared some new isoquinoline bases and these, with those to which reference was made in the last report, were submitted to the Medical Research Council for testing. A final report on them has not yet been received.

Carbohydrates [34–45]

22. *Sugar.* Miss Sambrook, working under the direction of Professor M. Stacey, F.R.S., studied methods for the determination of glucosamine, especially in the presence of substances with which it occurs in nature.

None of the colorimetric methods hitherto described, based on the colour given when an acid solution of *p*-dimethylamino-benzaldehyde reacts on the reaction product of glucosamine and acetyl acetone in alkaline solution, is entirely satisfactory.

The conditions of *p*H, temperature and time of heating have now been standardised to give satisfactory results and the maximum amounts of foreign materials which can be tolerated have been established.

In addition, other reactions of glucosamine upon which an analytical method might be based are being investigated, and some at this early stage are showing promise.

Studies on trifluoroacetate esters reported last year were extended. Full characterisation was completed of the products obtained by the benzoylation of 4 : 6-benzylidine trifluoroacetyl α-methylglucoside. The cyclic ketals o trifluoroacetone and mannitol and sorbitol are being further investigated. They are extremely stable compounds from which the trifluoroacetone residues cannot be removed by acidic or alkaline hydrolysis, by oxidation or reduction, and they may find industrial applications.

23. *Dextrans* (1). Notable contributions have been made in the field of dextran research by Professor Stacey and his collaborators at Birmingham University. Messrs. Bailey and Fleetwood proved by methylation and oxidation studies that the polysaccharide produced by the enzyme derived from *Acetobacter capsulatum* was a true dextran. The main linkages were of the 1:6-α-type with a small number of 1 : 4 linkages indicating a low degree of branching in the molecule. Thus the claim of Dr. E. Hehre of New York, based on serological evidence, that the enzyme can act on a polysaccharide possessing 1 : 4-α-linkages and by means of a " transglucosylase " action, can transform these into 1 : 6-α-linkages, is fully substantiated by chemical evidence.

The investigation of the structure of the dextran produced by a strain of *Betacoccus arabinosaceus* was completed and showed that it possessed one of the most highly branched structures known for a polysaccharide with 1 . 6-α-linkages and 1: 3-α linkages forming the branch points in the molecule.

Fundamental studies, which may be of considerable importance in the commercial production of dextran, are being undertaken with the object of isolating and characterising the enzymes respcnsible for the synthesis of the main chains of α-1 : 6-linked glucopyranose units and the branch points involving the α-1 : 3 linkages. Progress was made in separating the enzymic proteins in the organism from the mass of dextran. Infra-red analysis of dextran samples, isolated from growing cultures at different stages of growth and submitted to fractional precipitation with alcohol, showed the presence of branched and unbranched dextrans.

24. *Dextrans* (2). The aim of the research of Professor Frazer and his colleagues in the Department of Pharmacology, University of Birmingham, is to study the possibilities of developing drugs having anti-allergic actions. It was considered that one method by which such a compound could exert its effect would be by inhibiting the reaction which follows union of antigen and antibody. As part of this work it was found necessary to investigate further the biochemical reactions involved in the histamine release reaction. To this end, dextrans and dextran sulphates were found to be useful tools, since these polysaccharides are available in a range of molecular sizes, and were found to cause a release of histamine from rabbit blood cells *in vitro*.

Histamine release by dextrans was shown to be dependent upon concentration and molecular size. Under the experimental conditions employed, dextrans with molecular weights below 14,000 were not effective in this respect. In the case of dextran sulphate, samples having molecular weights below 10,000 did not release histamine, but inhibited the release due to a dextran sulphate of high molecular weight.

The " non-specific " actions of dextrans and dextran sulphates in blood, leading to the release of histamine from the cells, have many features in common with the " specific " action of antigen added to the blood of a sensitized rabbit.

25. *Starch.* Work carried out in Professor Peat's laboratory in the University College of North Wales provided additional evidence of the unbranched character of the maltosaccharides from amylose obtained by their reduction to the corresponding alcohols with sodium borohydride.

A new micro-method for the determination of the molecular weights of maltosaccharides, based upon this reduction technique, was developed. The reduction of starch fragments by borohydride will provide a useful method of exploring enzyme mechanisms.

In his studies on starch metabolising enzymes, Professor Peat has shown that the R-enzyme is able to effect complete debranching of the α-dextrin of waxy maize starch and rabbit liver glycogen. It will not, however, attack the α-1 : 6-linkages proved to be present in the α-dextrins of mussel glycogen (*Mytilis edulis*). The enzyme has been shown not to hydrolyse the 1 : 6-link attaching a single glucose unit to a maltosaccharide molecule, the smallest substrate for its action is believed to be the smallest branched molecule liberated by α-amylase from a ramified polysaccharide, namely, a pentasaccharide.

Studies in disaccharide synthesis by enzymic transglycosidation and by acid catalysis made good progress.

Professor Stacey and his collaborators prepared C^{14}-labelled glucose in which the degree of labelling is now being studied. The glucose was prepared by the hydrolysis of " labelled " starch synthesised by the agency of *Polytomella coeca* acting upon C^{14}-labelled acetic acid.

The labelled glucose was used to prepare labelled cellulose, synthesised by bacteria.

The use of alkaline ferricyanide was investigated by Mr. Bottle as a possible method of determining the molecular weights of polysaccharides by assay of the reducing end groups. A full kinetic study of the hydrolytic and oxidative degradations of amylose is in progress.

26. *Laminarin.* The " insoluble " laminarin of *L. cloustoni* was submitted in Professor Peat's laboratories to partial hydrolysis by acid, and the results obtained were unexpected. Whereas from published evidence one disaccharide and one trisaccharide would be expected, it was found possible to isolate in a state of purity three disaccharides and no less than five trisaccharides, one of which was crystalline. The disaccharides proved to be (i) laminaribiose (β-1 : 3-link) ; (ii) gentiobiose (β-1 : 6-link) and (iii) ββ-trehalose (1 : 1-link). The trehalose was, of course, non-reducing. These disaccharides were characterised by conversion into the known β-acetates. The five trisaccharides contained the permutations of the β: β-, β : 3- and β : 6-links to be expected from the nature of the disaccharides isolated. It is clear from these observations that the hypothesis which held laminarin

to be a linear chain is no longer tenable. From the relative proportions of the products isolated it is seen that the structure of laminarin is comparable to the ramified structure of amylopectin. The chain-forming link is the β : 3-link, the branches being attached by β : 6-links. It would appear also that at least the majority of the laminarin molecules do not have a reducing end inasmuch as the non-reducing $\beta\beta$-trehalose group is an integral part of the structure.

BRITISH WEST INDIES SUGAR RESEARCH SCHEME

Sugar Technological Laboratory, Trinidad. [46–57]

27. Experimental Sugar Factory: This factory was operated for ten weeks and 87 tons of yellow crystal sugar and 4,915 gallons of molasses were produced and sold during the experimental run. The period during which the factory operated was utilised not only for the collection of research data, but also for the training of a number of students in the technique of factory operation. South American factories have reported considerable benefit from the installation of superstats, and they have been installed in some British West Indian factories. During the experimental run of the pilot plant the amounts of scale formed in various vessels were measured both with and without the operation of superstats. The general conclusion was that superstats effected no significant difference in scale formation. The use of a Niagara filter gave a juice with higher clarity, but the cost of materials consumed in its operation precluded its economical installation. Messrs. Yearwood and Schmidt were also responsible for a number of other experiments in sugar technology, including an investigation on the use of bentonite in the factory.

28. *Cane Varieties.* Varietal studies from both the factory and laboratory angles were made by Messrs. Yearwood, Schmidt, Chadwick and Williams. The most important figure for evaluating variety remains the yield of sugar per acre, but valuable information was also assembled on wax yield, milling characters, clarification behaviour, and the lime requirements of the different varieties. In view of the possibility of extracting wax from filter cake, it is interesting to record that the yield of crude wax varied between 9·2 per cent. and 22·0 per cent., calculated on the dry cake and that the hard wax percentage varied between 26·6 and 44·3 per cent., calculated on the crude wax. These figures correspond to a yield varying between 16·1 and 87·4 lb. of hard wax per acre. Evidently variety is an important factor in wax yields.

29. *Sugar Cane Wax.* The commercial possibilities of extracting wax from filter cake was referred to in previous reports. Work on this project was continued by Messrs. Davison, Thomson and Yearwood. Apart from the varietal study mentioned above, the effect of burning the cane at harvest time on wax yield was examined. It was shown that with thorough burning, there was a loss of wax amounting to about 20 per cent. This finding, contrary to experience reported elsewhere, may be a reflection on the thoroughness of the burning technique adopted. Samples of dried filter muds collected from various West Indian factories gave yields of crude wax in pilot-plant operation varying between 8·3 and 16·8 lb. per 100 lb. of mud. Various solvents were tried for extracting the wax. Under certain conditions, the fusel oil technique gave promising results.

30. *Analytical Methods.* Work was continued by Messrs. Drake, Wise and Miss Marcus on the polarographic determination of aconitic acid in

molasses, samples of which were collected from many factories in the West Indies. Unfortunately, the results of their examination were disappointing, since all the samples contained less than the 2 per cent. deemed necessary for commercial exploitation. A few samples only, those from the Esperanza factory in Trinidad and the Caymanas factory in Jamaica, contained over 1·5 per cent., and work will be continued on the isolation of aconitic acid from molasses from these two factories. A method based on Prussian blue formation suggested as suitable for estimating sub-micro quantities of glucose and fructose was examined by Mr. J. H. Williams. It is hoped that the application of this method will in due course yield valuable information concerning the distribution of the sugars in various plant material. Mr. Williams also studied methods for determining lead in sugar-house products.

Messrs. Yearwood and Schmidt analysed bagasse for its residual sugar content (Pol%Bagasse) by its disintegration in high-speed homogenisers and obtained results of satisfactory accuracy. Use of such machines would considerably shorten the existing methods in laboratory use, but unless the machines could be improved they are unsuitable for the heavy duties involved. This problem has, therefore, been referred back to the machine manufacturers.

31. *The Amino Acids of Cane Juice.* Mr. Williams continued his work on the constitution of cane juice. By paper chromatography using a butanol-formic acid-water mixture, a greatly improved separation of the amino acids was obtained. Lysine now appears at the top of the chromatogram, and is easily distinguished from the leucines. The investigation of the juice during cane growth showed that the amino-acid content rose dramatically after the fifth month, and fell again after the eighth. Some interrelationship between the sucrose and amino-acid content was traced, and may foreshadow results of importance to the industry.

Leaf juice, in addition to cane juice, was studied by this technique. Both showed a surprisingly similar amino-acid pattern.

Work was also commenced on the yellow pigment present in cane juice, and methods elaborated for its approximate determination. Different varieties of cane were found to have a two-fold variation in content. As yet, the pigment itself has not been fully identified, but it may be related to 3:4-dihydroxybenzophenone.

32. *The Production of Lactic Acid and its Esters from Molasses.* Work on the production of lactic acid esters by Messrs. Chadwick and Schmidt concerned the reaction between lime and molasses solution at high temperatures. Conditions for optimum lactic acid production were established. With 1½ molecules of lime per molecule of hexose sugar, and with a sugar concentration of 22·5 per cent., the yield of lactic acid was 36·6 per cent. of the weight of the molasses used, a figure just over half theoretical. The effect of the alcohol on the yield of esters shows little difference as between n-butyl, isobutyl and isoamyl alcohols. This investigation has now reached a stage where it can be worked on a pilot-plant scale. A 30-gallon stainless steel autoclave for this larger-scale study has been ordered.

33. *The Production of Itaconic Acid by the Fermentation of Raw Sugar.* Itaconic acid can be used to yield polymerisable materials similar to the methacrylate or Perspex type plastic. Since methyl methacrylate sells at about 6s. per lb., sugar at 3½d. per lb. is a promising raw material for itaconic acid manufacture, and its experimental production was studied by Messrs. Winstanley and Wise. Static cultures of *Aspergillus terreus* on sugar-nutrient media were found to yield 20 per cent. of itaconic acid in ten days. The isolation of the itaconic acid proved to be easy, involving

only evaporation and crystallisation. For commercial production, static culture is unlikely to be suitable and, hence, methods similar to those used in penicillin production were applied. Promising results were obtained by efficient aeration and the use of fast-stirring mechanism in a stainless steel vessel. By this technique a ten per cent. yield was obtained in seven days and if this could be improved to 20 per cent., commercial production would be feasible. Apart from the itaconic acid, the mycelium would be a by-product, and its utilisation in tomato cultivation would appear to hold promise of development.

34. *Other investigations.* The preferential hydrolysis of the pentosans in bagasse can be accomplished by the action of 2½ per cent. sulphuric acid, the main product being xylose. So far, no important use for xylose exists.

Bagasse can be completely solubilised by hydrogenation in an autoclave using Raney nickel as a catalyst. Suitable conditions for a 100g. charge of bagasse in 1 litre of water in a 3 litre autoclave were found to be: 100 atmospheres pressure of hydrogen at a temperature of 240°–260° C. for 2½ hours. Under these conditions, complete solution of the bagasse is effected, the major products consisting of simple volatile hydrocarbons, together with relatively small yields of complex mixtures of polyhydric alcohols, esters and higher hydrocarbons. Ethylene glycol, propylene glycol, glycerol, tetrahydrofuran 2: 5 dicarbinol and acetol were identified, but the mixture contained other materials not yet identified. Yields were small, and this procedure for making glycol mixtures would not seem to be commercially worth while.

Timber Research [58–59]

35. The hydroxy-triterpenoid acid, $C_{30}H_{46}O_5$, present as a saponin in the timber makore (*Mimusops heckelii*) (C.P.R.C., 9th Annual Report, 1951–52, para. 58) was identified by Mr. J. A. Baker as bassic acid, a constituent of the seeds of several members of the family *Sapotaceae* (Heywood and Kon, *J. Chem. Soc.* 1940, 731). A new isomeric acid was also isolated from the wood. The results of periodate oxidation and the formation of formaldehyde from copper bronze dehydrogenation of the methyl ester of the new acid suggest the presence of the grouping $HO.CH_2\text{-}\dot{C}\text{-}CHOH\text{-}CHOH\text{-}$; the unreactivity of its lactone-forming double bond is typical of the α-amyrin series of triterpenes.

Further work was carried out on the production of hard-boards from secondary Colonial timbers at the Forest Products Research Laboratory. Early experiments showed that there was little difficulty in making boards with a very high strength property by means of the semi-chemical process but that the resistance to water of the boards was too low. A considerable part of the work carried out was, therefore, devoted to an investigation of methods of improving the water resistance of the boards. Two methods can be used, viz: (1) incorporation of sizing materials (rosin size or wax emulsions), and (2) hot air treatment of the finished boards. It was found that, while sizing caused a decrease in strength of the board, the heat treatment generally resulted in a small increase in strength. It appears that the hardwood pulps prepared by the semi-chemical process yield boards having rather lower water resistance than commercial board pulps. The difficulties in producing hardboards from Colonial timbers are likely to be largely economic, and the possibility of reducing the consumption of chemicals was therefore examined with a view to reducing to a minimum the operating costs of any process used.

Oils and Fats [60–61]

36. *Coconut Oil.* The component glycerides of the oil have now been determined by Dr. M. L. Meara and his collaborators. The oil consists of a very complex mixture of mixed glycerides, the components occurring in the greatest amounts being dilauromyristin 15·1 per cent. and lauromyristo-palmitin 12·7 per cent., no other component being present in amounts of more than 10 per cent. Lauric acid is the only acid which occurs twice in any of the triglyceride molecules, being present as dilaurocaprylin 5 per cent., dilaurocaproin 9·6 per cent., dilauromyristin 15·1 per cent., dilauropalmitin 7·4 per cent. and dilaurolein 0·5 per cent. The remaining components, 16 in number and comprising 81·8 per cent. of the whole oil, contain three different acids per triglyceride molecule and of these 79·5 per cent. contain lauric acid together with two other different acids. It is the higher content of glycerides of this category which determines to a large extent the physical properties of coconut oil, and which militates against any marked resolution of the oil into simpler fractions by solvent crystallisation.

37. *Copra Produced by Steam Processing.* Specimens of copra dried by injection of steam into Ceylonese coconuts were examined during the year. The moisture content was far in excess of that of a normal artificially or sun-dried copra (5–8 per cent.) and mould growth had developed extensively on the inner surface of the copra. The extracted oil, however, was of good colour and had a very low free acidity, indicating that no marked deterioration had occurred. The component fatty acids of the oil were determined and found to be in good agreement with the values found for commercial specimens of copra. Specimens of steam processed copra from Nigerian coconuts were examined and gave yields of the oil similar to those of commercial copra. The free acidities of the oils were significantly lower than that of an average commercial copra.

38. *Palm Kernel Oil.* The component fatty acids of a specimen of palm kernel oil were found to consist of glycerides of the following acids:— caprylic 2·4, capric 3·7, lauric 45·0, myristic 18·6, palmitic 8·5, stearic 2·5, arachidic 1·9, oleic 15·1, linoleic 2·1.

The sample of this oil was resolved into 10 fractions by exhaustive crystallisation. Determination of the component fatty acids of each fraction revealed that, as with coconut oil, the rigorous crystallisation did not give rise to any one fraction consisting of one individual triglyceride, but that a progressive separation of the less soluble from more soluble glycerides was obtained.

From the data obtained the component glycerides were computed. It was shown that lauric acid occurred in every glyceride molecule in palm kernel oil but that little (0·8 per cent.) trilaurin was present. Lauric acid occurred twice in 50 per cent. of the molecules of the oil, as dilauro-caprin 9·6 per cent., dilauromyristin 27·1 per cent., dilauro-palmitin 8·3 per cent., dilauro-olein 5·5 per cent., the remainder consisting of molecules in which lauric acid occurred only once, associated with two other different fatty acids. Further, 61·5 per cent. of the oil consisted of fully saturated glycerides, 37·3 per cent. of disaturated monounsaturated glycerides, the small remainder of 1·2 per cent. consisting of monosaturated diunsaturated glycerides.

39. *Locust fat.* On account of the anomalies encountered with small batches of experimental locusts found earlier, larger numbers of male and female *Locusta Migratoria migratorides,* obtained from the Antilocust

Research Centre, were examined. The fat content was variable both on a wet and dry basis. Exercise had an influence on fat content as would be expected. The characteristics (saponification equivalent, acid value and free fatty acid) were determined of the body fat, gut fat and ovary fat, and the constitution of a number of bulked fats of similar characteristics is under investigation.

Plants of Possible Medicinal or Insecticidal Value [62–65]

40. Dr. Barton and his collaborators have undertaken the work described in paragraphs 41 to 46.

41. *Hydrocotyle asiatica* (*Centella asiatica*). A sample from Kenya which was examined showed that the yield of crude triterpenoids was approximately 3g/Kg. (Ceylon material: 5g/Kg.).

42. The crude triterpenoid mixture yielded crystalline potassium and brucine salts. The brucine salt after several crystallisations was decomposed with acid and the liberated triterpenoid methylated. The behaviour of the resulting ester closely paralleled that already described for the ester obtained from the Ceylon material and no further progress could be made.

43. *Phyllanthol.* The chemistry of this interesting triterpenoid was investigated with a considerable measure of success. It was shown to be a cyclopropane derivative of α-amyranol, affording α-amyrin derivatives on isomerisation by acid.

44. *Daniellia oliveri Hutch.* Copal. Dr. F. Mathis carried out an investigation in which the copal was separated into acid and neutral fractions, both before and after saponification, and the various fractions were exhaustively chromatographed. Dr. Mathis, however, was unable to isolate any crystalline component from the copal.

45. *Lippis rehmanni Pears.* Excellent progress was made in studying the chemistry of icterogenin, and a formula was produced which is very probably correct. Confirmatory experiments are in hand.

46. *Tiliacora odorata.* A small quantity of this material, which is reputed to be a sheep poison, was examined in considerable detail, special attention being given to the basic fractions. Extracts from the leaves which were made to determine which fractions contained the toxic principle were tested for toxicity in mice by Messrs. Glaxo Laboratories, but none was found to be at all toxic. It must be concluded that either toxicity to mice is very different from toxicity to sheep, or else that the toxic principle is so labile that even the mild extraction procedures employed destroy it.

47. *Mitragyna alkaloids.* The alkaloid fraction from the bark of *Mitragyna rubrostipulaceae* was found to contain several component alkaloids in addition to mitraphylline. These still await complete identification. Mr. R. M. Gaily, under the supervision of Professor J. W. Cook and Dr. J. D. Loudon, was engaged in a systematic study of the degradation of mitraphylline. Several crystalline degradation products were isolated and characterised, and attention is now centred on their identification.

48. *Striga Germination Factor.* The collaborative work of the Botany Department of the University of Leeds and the Chemistry Department of the University of Cambridge on the chemical nature of the *Striga* germination factor continued. Analysis of the host root exudates by counter-current methods revealed the presence of palmitic and stearic acids which, however, were biologically inactive. Further concentration of the remainder of the product is in progress.

49. *Monamycin.* Professor C. H. Hassall and Dr. Violet Sharp collaborated in studies of improved methods of isolation and purification of monamycin. A new method was evolved which was an improvement on the original procedure and employed absorption and complex formation in a manner which could readily be applied to large-scale production. This method is now being used in a routine way for the preparation of further quantities of monamycin for chemical experiments. Mr. Magnus was engaged on studies aimed at separating and characterising the active compounds of the mixture of antibiotics in the monamycin complex.

Colonial Microbiological Research Institute [66–95]

Fermentation of the Cocoa bean

50. *Microbiological Study.* The final stages of the work reported fully in last year's report were completed and a comprehensive picture has been obtained of the functions of the microflora in the fermentation of cocoa beans as practiced in Trinidad. The investigation is being extended to cover the practices employed in other cocoa producing countries.

The study of chemical changes occurring in the bean during fermentation was continued. Efforts were concentrated on isolating the so-called "leucocyanidin" of the cacao bean which appeared to play an important part in the development of chocolate flavours. This met with some success and the ground was cleared for structural investigation of this compound.

51. *Polysaccharides from soil bacteria.* An investigation was made of the sugar components of the polysaccharides synthesised by mucilagenous bacteria selected at random from a tropical soil. In general the results agreed with those for temperate soils (Forsyth and Webley, J. Gen. Microbiol. (1949) *3,* 395) but a few isolates were obtained, producing mucilages composed of very complex sugar mixtures.

52. *The Study and Isolation of Antibiotics.* During the year under review the clinical trials with the fungistatic antibiotic comirin, which is produced by a motile bacterium isolated in Trinidad were completed. These trials were conducted under the supervision of Dr. M. A. Fawkes, Medical Superintendent of the Carribbean Medical Centre and of Dr. E. C. Richardson, an ear specialist of Port of Spain. The latter's investigations comprised fourteen cases of Otomycosis—sometimes described as "Tropical Ear", and the application of comirin proved effective in twelve cases, where the isolated organisms were an *Aspergillus* species or the yeast *Candida parapsilosis.* Two cases, from which no fungi or yeasts were isolated, remained refractive. The micro-organisms isolated from these cases were short motile rods, resembling *Bact. fluorescens.* The medical literature sometimes distinguishes between dry and wet infections, attributing the former to fungus, the latter to bacterial infections. Dr. Richardson's observations would appear to indicate that no such division is invariably justified, since some of his cases were definitely "wet" despite being caused by a species of *Aspergillus.*

The remarkable effect of comirin on cases of *Otomycosis* can probably be attributed to the fact that the causative organism invades the surface only of the epithelium in the meatus, or outer ear passage, and does not penetrate deeply below the surface. The evidence gathered from Dr. Fawkes' investigations on the value of comirin in the treatment of various forms of Tinea would appear to support this belief.

Dr. Fawkes in his report, comprising 24 cases of various forms of Tinea, reports that clinical cure was obtained in at least eight cases of Tinea; *T. cruris, T. pedis, T. corporis, T. tonsurans* and *T. interdigitale.* There was evidence to suggest that comirin had a strong suppressive action in a further nine cases, of which four may have suffered a reinfection. Of the remaining cases two must be regarded as failures, while three could not be assessed because the patients defaulted during treatment and could not be traced. Finally one case, which was thought to be chronic blastomycosis, was proved not to be so. It did not respond to treatment with comirin.

Attempts to explain the reason for the reported failure of comirin in two cases has occupied the attention of the staff of the Colonial Microbiological Research Institute for a considerable time.

While the clinical trials were in progress the Colonial Microbiological Research Institute had ample opportunity to isolate dermatophytes, and a series of these, including *Malassezia furfur,* which has but rarely been isolated from infected skin, is now maintained in the Hankey Culture Collection. It was possible to confirm that identical clinical symptoms may be caused by different fungi.

The medium used throughout for the isolation of dermatophytes was standard Sabouraud agar, to which 2 mg. of penicillin was added per 10 ml. of medium. The presence of the penicillin greatly assisted in checking the development of Gram+cocci, which so often interfere with the development of the slower growing dermatophytes.

In addition to work on comirin the staff started exploring a tropical habitat for the presence of fungistatic antibiotics. One fungus was obtained which produced a fungistatic antibiotic of considerable interest. It was shown that this antibiotic could be produced on simple media containing no added peptone; that it could be extracted from these media by ether and that it was *not haemolytic.* In addition to being fungistatic it had a bacteriostatic action on Gram+bacteria.

The resistance of a large number of fungi and yeasts to comirin was evaluated during the year. It is gratifying to report that all the dermatophytes which were isolated from human lesions, proved highly sensitive, growth in most cases being arrested in comirin solutions as low as 1-3 millions.

During the year a comprehensive report on the work done on comirin was submitted to the Director of the Colonial Products Research and to the National Research Development Corporation who have protected the production and use of comirin by patents in various countries.

53. *Panama Disease Investigations.* It was ascertained that *Fusarium oxysporum cubense* was highly resistant to comirin and further work in this field was therefore postponed until new fungistatic antibiotics become available.

54. *Sterol Work.* Owing to the availability of cheaper and more readily available intermediaries than ergosterol for the synthesis of endocrine steroids, this work was abandoned.

55. *Hankey Culture Collection.* Very few additions were made this year to the culture collection which now comprises 547 strains (78 actinomycetes, 106 bacteria, 106 yeasts and 257 fungi). Most of the cultures added were dermatophytes isolated in connection with work on the Institute's antibiotic, comirin. Skin scrapings from human and animal infections were received for examination from Jamaica and West Africa. A strain of *Malassezia furfur* was grown from a case of Tinea versicolor.

Work is progressing on a survey of the distribution of *Fungi Imperfecti* in Trinidad soils.

56. *Miscellaneous investigations.* During the year 1951–52 the Institute was again called upon to assist various industries and organisations in developing and expanding their activities.

(a) *The Co-operative Coconut Growers Association of Trinidad and Tobago* reorganised their margarine production under the guidance of the Institute. The efforts of reorganisation of this local industry have so far been successful and the Director of the Institute has agreed to maintain regular supervision of the margarine manufacture and to supply pure cultures of the required lactic acid producing bacteria.

(b) *The High Commissioner of Australia to Trinidad and Tobago* was assisted in the bacteriological examination of tinned milk.

(c) *The Trinidad Match Factory* was given advice on the prevention of mildew development on their products.

(d) *The Institute* has undertaken work for the Institute for Seaweed Research, Inveresk, Scotland, on the fermentability of various seaweeds by yeasts.

(e) *The Trinidad Forest Department* asked for assistance in supplying mycorrhiza producing fungi for *Pinus carribea,* which it was proposed to introduce into the colony. They were given advice as to the procedure to be adopted.

57. *Engineering Section.* Workshop assistance was rendered to three local organisations during the year:—

(a) *The Government Chemist* requested the design and construction of a jig for drilling carbon electrodes for spectographic work which was provided.

(b) *The Marketing Board* sought, and was given, advice on the design and construction of a pilot plant for the smoking of fish.

(c) *The Coconut Growers Association* was given advice and assistance in the running of newly installed machinery for the manufacture and packing of margarine.

(d) *The Works and Hydraulics Department* requested assistance in the construction and completion of various equipment installed at the Colonial Microbiological Research Institute.

Corrigenda to 1950–51 Report:—

Brachylaena hutchinsii (Kenya). On p. 53, para. 87, of Colonial Research 1950–51, it was stated that the yield of essential oil from the wood of this tree was 3·5 per cent. We learn from Dr. G. Pickering that the oil investigated was an ether extract of the wood which would contain resins and other materials which are not present in oils obtained by steam distillation. The yield of essential oil would therefore be less than 3·5 per cent.

Publications

Cacao Polyphenolic Substances. I. Fractionation of the fresh bean. Forsyth, W. G. C. *Biochem. J.*, 1952, **51,** 511–520.

The extraction of cacao pigments. Forsyth, W. G. C., and Rombouts, J. E. *J. Sci. Food Agric.*, 1952, **3,** 161–164.

The Fermentation of the Cocoa Bean. Thaysen, A. C., and Forsyth, W. G. C. *J. Cocoa, Chocolate and Confectionery Alliance*, 1952, Vol. 4, No. 12, 181–183.

The Occurrence of Fructose in Rabbit-Liver Glycogen. Peat, S., Roberts, P. J. P., and Whelan, W. J. *Biochem. J.*, 1952, **51,** xvii (Proc.).

Action Pattern of Salivary α-Amylase. Roberts, P. J. P., and Whelan, W. J. *Biochem. J.*, 1952, **51,** xviii (Proc.).

Action Pattern of Potato Phosphorylase. Bailey, J. M., and Whelan, W. J. *Biochem. J.*, 1952, **51,** xxxiii (Proc.).

The Minimum Chain Length for Q-Enzyme Action. Bailey, J. M., Peat, S., and Whelan, W. J. *Biochem. J.*, 1952, **51,** xxxiv (Proc.).

Evidence of Multiple Branching in Waxy Maize Starch. Peat, S., Whelan, W. J., and Thomas, Gwen J. *J. Chem. Soc.*, 1952, 4546.

Action of Salivary α-Amylase on Amylopectin and Glycogen. Whelan, W. J., and Roberts, P. J. P. *Nature*, 1952, **170,** 748.

Synthetic Action of Almond Emulsin. Peat, S., Whelan, W. J., and Hinson, Mrs. K. A. *Nature*, 1952, **170,** 1056.

The Enzymic Synthesis and Degradation of Starch. Part XVIII. The Minimum Chain-Length for Q-Enzyme Action. Peat, S., Whelan, W. J., and Bailey, J. M. *J. Chem. Soc.*, 1953, 1422.

Mechanism of Carbohydrase Action. Part I. Preparation and properties of Maltodextrin Substrates. Whelan, W. J., Bailey, J. M., and (in part) Roberts, P. J. P. *J. Chem. Soc.*, 1953, 1293.

Mechanism of Carbohydrase Action. Part II. α-Amylolysis of Linear Substrates. Whelan, W. J., and Roberts, P. J. P. *J. Chem. Soc.*, 1953, 1298.

The Striga germination factor. 2. Chromatographic separation of crude concentrates. Brown, R., Johnson, A. W., Robinson, E., and Tyler, G. J. *Biochem. J.*, 1952, **50,** 596.

Chemical Factors involved in certain host-parasite systems. Long, A. G. *Ph.D. Thesis*, Cambridge.

The nature, origin and effects of compounds which stimulate the germination of the seed of S. *hermonthica* Benth. Robinson, E. *Ph.D. Thesis*, Leeds.

The Striga germination factor. Tyler, G. C. *Ph.D. Thesis*, Cambridge.

Studies of Trifluoroacetic acid, Part IV. Bourne, E. J., Stacey, M., Tatlow, Mrs. C. E. M., and Tatlow, J. C. *J. Chem. Soc.*, 1951, 826.

The Chloromethylation of eugenol and the preparation of some new isoquinoline bases. Clemo, G. R., and Temple, R. W. *J. Chem. Soc.*, 1953, 678.

Colonial
Social Science Research Council
Ninth Annual Report
(1952-1953)

Institute of Advanced Legal Studies,
25, Russell Square,
London, W.C.1.
7th August, 1953.

SIR,

I have the honour, on behalf of the Colonial Social Science Research Council, to transmit to you the Ninth Report of the Council, covering the period from 1st April, 1952, to 31st March, 1953.

I have the honour to be,
Sir,
Your obedient servant,
(Sgd.) D. HUGHES-PARRY.

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

Membership

PROFESSOR SIR DAVID HUGHES-PARRY, M.A., LL.D., D.C.L., Director of the Institute of Advanced Legal Studies (*Chairman*).

PROFESSOR FRANK DEBENHAM, O.B.E., M.A., Professor Geography, University of Cambridge.

PROFESSOR E. E. EVANS-PRITCHARD, M.A., Professor of Social Anthropology, University of Oxford, and Director, Institute of Social Anthropology, University of Oxford.

MR. L. FARRER-BROWN, J.P., Secretary, The Nuffield Foundation.

PROFESSOR VINCENT HARLOW, C.M.G., M.A., D.Litt., Beit Professor of History of the British Empire, University of Oxford.

MR. H. V. HODSON, M.A., Editor of the "Sunday Times", formerly a Reforms Commissioner, Government of India.

MR. W. B. L. MONSON, C.M.G., Assistant Under Secretary, Colonial Office.

MISS MARGERY PERHAM, C.B.E., M.A., Fellow of Nuffield College, University of Oxford.

PROFESSOR SIR ARNOLD PLANT, B.Sc. (Econ.), B.Com., Sir Ernest Cassel Professor of Commerce, University of London.

PROFESSOR MARGARET READ, C.B.E., M.A., Ph.D., Professor of Education and Head of Department of Education in Tropical Areas, Institute of Education, University of London.

PROFESSOR SIR RALPH TURNER, M.C., M.A., Litt.D., F.B.A., Director of the School of Oriental and African Studies, University of London.

SIR JOHN WADDINGTON, G.B.E., K.C.M.G., K.C.V.O., Director of the International African Institute.

MRS. E. M. CHILVER (*Secretary*).

Terms of Reference

The terms of reference of the Council are to advise the Secretary of State on matters relating to research in the social sciences in or for the benefit of the Colonial Empire.

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

CONTENTS

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

NINTH ANNUAL REPORT

I. INTRODUCTION

The Council held four meetings during the year 1st April, 1952, to 31st March, 1953, and four meetings of the Committees took place.

2. Mr. C. G. Eastwood, C.M.G., resigned from the Council on leaving the Colonial Office to take up his duties as Commissioner of Crown Lands.

3. Mr. W. B. L. Monson, C.M.G., an Assistant Under Secretary in the Colonial Office, accepted the Secretary of State's invitation to be a member of the Council.

4. In the course of a Long Vacation Visit to South African Universities Professor Sir Arnold Plant was able to visit the East African Institute of Social Research and to discuss with the Principal of Makerere College and the Director of the Institute its proposed programme of work on the economic side.

5. Mr. Farrer-Brown in the course of a similar visit was able to have discussions with the Directors of the Rhodes-Livingstone Institute and the East African Institute of Social Research.

6. The Secretary of the Council attended a meeting in Kampala at the end of February of persons engaged in the planning of social research in Africa convened by the Council for Scientific Co-operation in Africa south of the Sahara.

II. GENERAL

7. Revisions in Colonial Research Service terms under which the majority of field workers carrying out investigations under the auspices of the Council are recruited have been or are in the course of being made. These revisions will involve supplementary provision in addition to the provision made during 1951 for cost-of-living increases.

8. At the end of the year £174,500 remained unallocated out of the allocation of £325,000 made in October 1951 for research in the Social Sciences. After a survey of commitments, and taking into account possible savings on earlier schemes, the Council decided that a few new schemes could be considered, and decided to set aside a sum of £10,000 to finance Junior Fellowships, attached to Colonial Universities and Colonial University Colleges during the period 1953–1956.

9. There has been little change in the recruitment position since last year; difficulties are still being met with in the recruitment of senior staff and in the fields of demography and legal sociology.

10. Of the 15 graduate students recruited under the special scheme for training post-graduate research workers, two are still in the field, and the remainder are either writing up their material at British Universities or have presented their reports. No Colonial Research Fellowships in the social sciences have been awarded during the year.

11. Of the five American social anthropologists appointed under the special scheme for training American scientists at British Universities, all have now

returned from the field and are writing up their material. Dr. E. H. Winter's report on the Baamba is in its final stages and will be published under the auspices of the East African Institute of Social Research.

12. The Goldsmiths' Company has decided to award two scholarships tenable at African University Colleges in 1953: and the Leverhulme Trust Fund has offered its assistance to members of the staffs of Colonial Universities and University Colleges. The Nuffield Foundation is financing social research in Sierra Leone and studies in the United Kingdom of colonial interest. The Wenner-Gren Foundation has assisted recipients of Colonial Development and Welfare grants and has financed independent studies in Africa, and documentary studies of colonial interest in the United Kingdom. The Social Science Research Council of New York has financed a number of field studies in colonial territories; and the Carnegie Corporation of New York, by financing visits of eminent American social scientists has helped to keep scholars in British colonial territories in touch with current work in American Universities.

Fulbright awards made during the year to American scholars include awards made to a historian tenable at the University College of the West Indies, and to a human geographer, tenable at Makerere College. Professor M. J. Herskovits, many of whose students have been engaged in field studies in Africa, has visited the University College of the Gold Coast under Fulbright auspices.

III. THE REGIONAL INSTITUTES OF SOCIAL AND ECONOMIC RESEARCH

13. On the invitation of the Secretary of State for the Colonies the Council was invited to give consideration to the probable requirements of Colonial Development and Welfare assistance to the Institutes after the 31st March, 1956, and to report generally upon them. The Council decided that the best method of meeting the Secretary of State's wishes was by means of visitations to each Institute on the model of those conducted by the University Grants Committee to academic institutions in Britain. At the invitation of the Principal of the University College of the West Indies the first of these visitations was made to the West Indies Institute of Social and Economic Research (the first to be established) by Mr. L. Farrer-Brown and Dr. J. R. Raeburn, a member of the Colonial Economic Research Committee, at the end of March, 1953. Thanks to the co-operation of the College authorities and the Director, the visitation proved to be a most useful one.

14. The Senate of the University of Malaya has resolved to set up a Social Research Unit. The staff of the Unit will consist initially of a Directing Secretary, University Research Fellow and Colonial Development and Welfare Research Fellow, holders of junior fellowships and research studentships financed by the Government of the Federation of Malaya, and a research fellow seconded by the Government of Singapore. The Unit will work under the general direction of a Social Research Committee of the University, and will start work in 1953.

15. Detailed reports of the work of the regional Institutes are given in Appendices I–VI.

IV. RESEARCH IN THE COLONIAL TERRITORIES FINANCED INDEPENDENTLY OF COLONIAL DEVELOPMENT AND WELFARE FUNDS

16. A good deal of research is now being carried on independently of Colonial Development and Welfare assistance as an essential part of administration. Some of the principal projects in progress during the year are outlined below:—

17. *East Africa High Commission.* The East African Statistical Department has been studying the best methods of estimating population growth in under-developed territories.

Further scientific examinations were made of the information from the 1948 population census and estimates of fertility by tribe and by location were made. Research continued on the possible age distribution of the African population.

An experiment was carried out at the time of the 1952 non-African population census of Tanganyika to discover whether it was scientifically accurate to use estimates of total fertility to estimate age specific fertility rates and thus, indirectly, birth rates. Special information was collected from all women who had borne a child since 1st January, 1951, and preliminary results seem to justify the estimates previously made on the basis of total fertility.

18. *Tanganyika.* The three sociologists employed by Government have been occupied during the period as follows:—

Mr. H. A. Fosbrooke, apart from his visit to the United States on a Fulbright travel grant, continued his study of the sociological aspects of land usage in the heavily populated highland areas of Northern Tanganyika, with particular reference to the deterrents which have hitherto operated against migration to and settlement in the adjacent plains.

Mr. Hans Cory's book on Sukumaland law and custom is being published in both English and Swahili. A short study of Sukuma chiefship and its rituals has been published by the East African Literature Bureau, and a longer monograph will be published in the East African Institute of Social Research's Monograph series. In the course of the year Mr. Cory carried out an investigation of the law and customs of the Nyamwezi tribe in the Western Province. This enquiry is now being extended to cover the political institutions of the three districts concerned. Mr. Whiteley, prior to his appointment to the East African Institute of Social Research, completed his study of the Makua tribe in the Southern Province, and arrangements are being made to publish his results. His successor, Dr. Gulliver, arrived in October, 1952, and is making a general study of the Ngoni in the Southern Province before starting a study of labour mobility, one of the projects contained in the Stanner programme.

Mr. A. C. A. Wright was seconded to the Sukuma Development Team as Sociological Research Officer, and after completing investigations and submitting papers on land tenure, cattle holding and animal husbandry in Central Busukuma and on the Sukuma House and Homestead, undertook a survey of the structure of the Sukuma clan organisation.

19. *North Rhodesia.* The Education Department has been applying Moray House intelligence tests and attainment tests in English and Arithmetic to all European scholars in the $10\frac{1}{2}$ to $11\frac{1}{2}$ age groups with a view to finding preliminary answers to such questions as relative standards between children

in Northern Rhodesia and elsewhere, and between children born in Northern Rhodesia and those born elsewhere; the effect of a different mother tongue on education and progress and of other factors such as health, occupation of parents, etc. The work was carried out in conjunction with similar tests by Moray House in Southern Rhodesia.

Work on the adaptation of Moray House tests to African scholars is in progress at Munali Secondary School.

Investigations were continued during 1952 into the selection of words for basic vocabularies in the context of African-European contact. The languages chosen were Bemba, Nyanja, Tonga, Lozi and English.

The Northern Rhodesia Publications Bureau now possesses its own tape recorder and folk tales and traditional history are being recorded with the intention of publishing results at a later date.

The Rhodes–Livingstone Museum is undertaking research into the archaeology of Northern Rhodesia, the material cultures of Northern Rhodesian tribes (particularly the Hutwer Bushmen and the tribes of Southern Barotseland) and into the structure of rhythm and melody in African music.

20. *Singapore.* The Education Department of the University of Malaya reports that work is being done or projected as follows:—

(*a*) Construction of achievement tests in English and Arithmetic for use in schools with English as the medium of instruction but not the mother tongue of the pupils;

(*b*) Attempts to standardise for local use existing non-verbal intelligence tests and construction of others;

(*c*) Investigations of the validity and reliability of estimates of children's ability and progress as given by teachers of various races;

(*d*) Investigation of language problems, particularly with regard to the teaching of English as a second language;

(*e*) A sociological survey of pupils in English-speaking schools;

(*f*) Preparation of graded language materials for health education.

The word-frequency count of written Malay previously reported was completed. A first 1,000-word list was available for use in preparing stage 2 readers for the Malay literacy campaign in the Federation of Malaya by Dr. Frank Laubach in the middle of 1952. A copy of the report on this count in both Malay and English is being published by the University of London Press.

The Social Research section of the Department of Social Welfare was confined in 1952 to a number of small investigations, including a study of retirement habits of the population and investigation into the system of retailing vegetables, a study of opium addicts and research into sampling techniques as applied to conditions in Singapore. Towards the end of the year a staff of part-time field interviewers was recruited and trained in preparation for a large-scale enquiry in 1953 into the extent, distribution and cause of urban poverty in Singapore.

21. *Sarawak.* Apart from the socio-economic survey of the Malay community undertaken with Colonial Development and Welfare funds, the Curator of the Sarawak Museum has carried out a further field expedition into the Kelabit country as part of his continuing study of changes in that community, the observations having started in 1945.

Good progress has been made in the first intensive study of the archaeology of the Colony.

Another number of the Sarawak Museum Journal has been issued with a wide range of anthropological and sociological papers.

22. A summary of social research in progress in Africa is being collated by the Council for Scientific Co-operation in Africa south of the Sahara for wide dissemination, and will include an account of work in progress at the African University Colleges. No account of this work, which is now becoming considerable, is given in our report for this reason.

23. Mention should be made here of the work of the University of Hong Kong members of whose staff are engaged in studies of industrialization, social studies in Hong Kong itself, and in the preparation of an economic history of China. An Institute of Oriental Studies is established in the University.

V. COLONIAL DEVELOPMENT AND WELFARE PROJECTS IN PROGRESS

Projects undertaken by the International African Institute

24. *Ethnographic Survey of Africa.* During the year 1952–53 seven sections of the Survey have been published, making a total of 15 volumes. Eight other sections are at the moment in the press and five others are almost completed. Material collected by Mr. Gunn during his field study in Nigeria has provided for two sections, and is expected to furnish the substance of two others. Dr. Meinhard's material is now being written up and should be ready for press this summer.

Two sections prepared by French ethnologists are being printed in Paris with the aid of funds provided by the governments of French West Africa and French Cameroons and a third volume in French is ready for publication. One of the sections prepared in Belgium, and financed by the Belgian Government, is now in the press and a number of others are in preparation. A French publisher (Payot of Paris) has requested permission to translate and publish the volume on the *Kikuyu and Kamba,* by John Middleton.

In spite of experiments in various methods of reproduction, publication costs remain high, although an improvement has been effected in speed of production. Sales are satisfactory, especially in the U.S.A., and a number of standing orders for the whole series have been placed. Much thought and effort have been applied to securing publicity for these publications, but it is felt that more could and should be done in this matter.

An application has been made for a small additional grant to enable work actually in hand concerning British Territories to be completed and published.

25. *Handbook of African Languages.* Part II of the General Survey—*The Languages of West Africa* by D. Westermann and M. A. Bryan, was published last autumn. Part III, *Languages of East Africa,* is being prepared for press. Two special studies, *The Southern Bantu Languages,* by Professor Doke of Witwatersrand, and *Bantu Languages of Equatorial Africa,* by Professor Guthrie, are now in the press and publication may be expected in October next.

The cost of publishing these linguistic studies is very high; the International African Institute is contributing £500 of its own funds towards the publication of Professor Doke's study.

26. *Northern Bantu Survey.* Reports from the two teams of investigators, including extensive maps, have been prepared for press. Inclusion of field material provided by Professor Tucker and Miss M. A. Bryan has made it possible for this report to cover the whole central zone of Africa, from the west coast to the Indian Ocean.

In the complete absence of written information, the description of some of the languages included in the Survey has presented many orthographical problems.

Other African Projects

27. *Study of French Administration in North Africa.* Miss S. E. Crowe, who has already published a number of papers as a result of her investigations under the supervision of the Colonial Studies Department of the University of Oxford, is still at work on her book which will, it is hoped, be eventually published in a series of studies under the editorship of Miss Margery Perham.

28. *Land Tenure in British Africa.* Dr. C. K. Meek has, unfortunately, had to hold up his researches owing to ill-health. They will be resumed as soon as his medical advisers allow.

29. *Islamic Law in Africa.* Mr. J. N. D. Anderson, Reader in Islamic Law at the University of London, is now correcting the proofs of his synoptic survey of Islamic Law and Procedure in British territories in Tropical Africa and Aden.

30. *Socio-Economic Survey, Zaria, Nigeria.* Dr. M. G. Smith has submitted two further reports, on the Kagoro and Kadara, to the Government of Nigeria and has prepared a number of papers on special aspects of his work for publication in learned journals. A life history of an old Hausa lady transcribed and edited by Mrs. Smith, with an historical introduction and annotations by Dr. Smith, is under consideration by a publisher.

Dr. Smith has now been appointed to the staff of the West Indies Institute of Social and Economic Research and is working in Grenada.

31. *Socio-Economic Survey of the Mba-Ise, Owerri, Nigeria.* Mr. E. W. Ardener has presented a very full interim report on his work to the Government of Nigeria. The report is now under consideration by the Council.

32. *Socio-Economic Survey of Oshogbo, Nigeria.* Mr. Schwab, one of the sociologists selected under the special scheme of recruitment for American graduates, has published some material on the religious composition of the Oshogbo and is revising the first volume of his report on his survey.

33. *Economic Position of Women in the Cameroons (Bamenda).* Dr. Phyllis Kaberry's report was issued in the Colonial Research Publications series under the title "Women of the Grassfields" and has been well reviewed.

34. *Field Study of the Nomadic Fulani, Northern Nigeria.* Mr. D. J. Stenning, a Goldsmiths' Scholar, whose field work is assisted by a Colonial Development and Welfare grant, returned to Cambridge to make a preliminary analysis of his material in the course of the year. He submitted a full and interesting interim report on his work to the Council and to the Goldsmiths Educational Trust, and has now returned to Nigeria for a second tour. Mr. Stenning is working in close co-operation with Mr. F. de St. Croix, seconded by the Government of Nigeria, and Mr. C. E. Hopen, a Canadian anthropologist, who is working on the same topic under

the auspices of the International African Institute and the Rockefeller Foundation. The French Government is co-operating in the scheme and a conference of British and French research workers engaged in Fulani studies was held in Nigeria during the year.

35. *Ethnographic Study of the Idoma People of Benue Province.* Dr. R. G. Armstrong returned to Nigeria for a second tour after study leave at Oxford, in the course of which he prepared a section on the Idoma for the *Ethnographic Survey of Africa.* He has now completed his field work and is now on the way home to the United States, stopping for consultations with his supervisor Professor Evans-Pritchard at Oxford en route. He has made a rich collection of ethnographic and linguistic material which he hopes to publish in several forms. These include a major monograph on the Idoma and an Idoma dictionary.

36. *Ethnographic Study of the Lobi, Gold Coast.* Mr. Jack Goody returned to the Gold Coast for a second tour after completing an interim report on the sociology of the Lobi which has been presented to the Government of the Gold Coast. He returned from the Gold Coast at the end of 1952 and is now writing up further material collected in the form of special studies on various aspects of Lobi history, social structure and economy under the supervision of Professor Fortes.

37. *Psychological Testing in the Gold Coast.* Dr. Geoffrey Tooth has returned from the Gold Coast and has presented a report to the Government of the Gold Coast on the use of unadapted tests as measures of aptitude and scholastic achievement.

38. *Study of Proprietary Law in the Gold Coast.* Mr. A. N. Allott, Lecturer at the School of Oriental and African Studies, working under the supervision of Professor Vesey Fitz Gerald has now practically completed his report which will probably be published independently of the Colonial Research series.

39. *Socio-Economic Survey of the Rural Areas of the Colony Peninsula of Sierra Leone.* Miss E. M. Richardson and Mr. G. R. Collins have presented a very comprehensive report to the Sierra Leone Government. Publication is now being considered by the Council. Miss Richardson has now been appointed to the Rhodes–Livingstone Institute and Mr. G. R. Collins to the Gambia Oilseeds Marketing Board.

40. *Sociological Research, Gambia.* Mr. D. P. Gamble has now returned to the Gambia to carry out an investigation of the Fulla and Serahuli tribes. He has presented reports to the Government of the Gambia on his investigations in the villages of Kerewan and Keneba and has published material on the Mandinka language. The Government of the Gambia is contributing a proportion of the costs of this investigation which is under the supervision of Professor Daryll Forde.

41. **Field Study of the Tiv of Benue Province.* Drs. P. J. and Laura Bohannan of Oxford University were awarded a travel grant to enable them to make a further tour to complete investigations amongst the Tiv which had been financed by a grant from the Wenner-Gren Foundation. Dr. Laura Bohannan has already published a study of Tiv lineage systems and Dr. Paul J. Bohannan has a study ready for publication.

42. **Cameroons Development Corporation Labour Force.* A grant has been awarded to Mr. M. J. Ruel, a postgraduate student of Oxford University, to work in association with the survey organised by the West African

* New project started in the year under review.

Institute of Social and Economic Research and the Cameroons Development Corporation into the composition of their labour force, its informal organisation and the impact of Corporation welfare projects, motives for migration, and attitude to work. Mr. Ruel will work amongst the Banyangi tribe in the Mamfe Division who supply the second largest contingent in the Cameroons Development Corporation labour force. He will study motives for migration as a part of a more general study of village organisation.

43. *Linguistic Research in the Somaliland Protectorate.* Mr. Andrzejewski, who has completed his field work and study leave, is preparing further material for publication. He is now on the staff of the School of Oriental and African Studies.

44. *Study of the Kikuyu Family, Kenya.* Dr. Jeanne Fisher has completed her field work and has already submitted some reports to the Kenya Government with special reference to child development, domestic economy and women's agricultural work. Further reports are being prepared, including one on land tenure.

45. *Study of the Teita, Kenya.* Mr. Alfred Harris and his wife, Mrs. Grace Gredys Harris, two American anthropologists recruited under the special scheme, have completed their field work and are now writing up their material under Professor Fortes' supervision at Cambridge. They have already submitted an interim report outlining the social organisation of the Teita.

46. *Anthropological Study of the Galla of N.E. Kenya.* Mr. P. T. W. Baxter, who was recruited under the Social Science Studentship scheme, is now in the last stages of his field work and is extending his investigations to the Sakuye, Gabbra and Ormo. Mr. Baxter has covered a great deal of ground under tough conditions.

47. *Anthropological Study of the Turkana and Jie.* Dr. Phillip Gulliver has completed his monograph on the Turkana and Jie which is to be published with the permission of the Kenya and Uganda Governments. Dr. Gulliver has now joined the Tanganyika Government's Sociological staff and is working among the Ngoni in the Southern Province.

48. *Anthropological Study of the Lugbara and Madi, Uganda.* Mr. J. F. M. Middleton has presented an interim report to the Uganda Government on Lugbara labour migration and is now in the final stages of his main report. Mr. Middleton, a Goldsmiths' Scholar, assisted by a Colonial Development and Welfare grant, and during his writing-up period by a grant from the Wenner-Gren Foundation, may revisit the field as the leader of an Oxford University expedition.

49. *Anthropological Study of the Alur and Jonam, Uganda.* Dr. Southall has completed his thesis under Professor Schapera's supervision: it is being revised for publication in a series of monographs to be published under the auspices of the East African Institute of Social Research. Dr. Southall is now engaged in organising a survey of African labour in Kampala undertaken by the East African Institute of Social Research.

50. *Anthropological Study in the Bwamba-Konjo Area, Uganda.* Dr. E. H. Winter returned for study leave to the United States in the course of the year and was awarded his Ph.D. (Harvard). He has now returned to the East African Institute of Social Research. His thesis is being revised for publication in the East African Institute Monograph series.

51. *Anthropological Study of the Toro, Uganda.* Mr. Brian Taylor has returned to the United Kingdom to write up his material on the Toro. His work has, unfortunately, been held up by illness but should be complete soon. He will be returning to Uganda in 1953 as a Community Development Officer.

52. *Study of the Barabaig, Tanganyika.* Mr. Gordon Wilson, a Canadian post-graduate student, has now returned to the United Kingdom to write up his material at London University. Reports had been submitted to the Tanganyika Government, one of them of a confidential nature dealing with the outbreak of murders by the Barabaig. Mr. Wilson will shortly be returning to Kenya to undertake an investigation on behalf of the Kenya Government into Luo customary law and land tenure.

53. *Legal Studies in Northern Rhodesia.* Mr. Arnold Epstein completed his report during the year which was published in the Colonial Research Studies series under the title "The Administration of Justice and the Urban African". He has now been appointed to the staff of the Rhodes–Livingstone Institute.

54. *Social Survey, Zanzibar.* The analysis of the material is now virtually complete and Professor Edmund Batson hopes to submit his report to the Government of Zanzibar in 1953.

55. *Study of Administration by Native Authorities, Nyasaland.* Dr. Lucy Mair's report has been issued in the Colonial Research Studies series.

56. *Native Land Tenure in Basutoland.* The Government of Basutoland has agreed to the publication of Dr. Vernon Sheddick's report and arrangements for publication are in train.

South-East Asia and Pacific

57. *Anthropological Studies in Sarawak.* Work on the programme of studies proposed by Dr. Edmund Leach (cf. Colonial Research Studies No. 1) is well advanced. Dr. William Geddes has presented his major report on the Land Dyak to the Government of Sarawak who have recommended publication. It is now in the press.

Mr. H. S. Morris has completed his report on a Melanau community engaged in sago production. It is now in the press and will be issued in the Colonial Research Studies series. Mr. Morris has now joined the staff of the East African Institute of Social Research.

Mr. J. D. Freeman has nearly completed writing up his reports on the Iban (Sea Dayak) and has already made some of his results available in addresses to the Royal Anthropological Institute and Royal Empire Society. A report on Iban social organisation, agriculture and land tenure has already been presented to the Government of Sarawak, and a further report on political organisation is in progress. Apart from writing reports directed mainly to those aspects of Iban society which are of importance to administration, Mr. Freeman is organising his material on Iban religion. This is of quite remarkable scientific and aesthetic interest. Mrs. Freeman has been working on Iban crafts, especially weaving.

Dr. J. K. T'ien's work on the Chinese community in Kuching is to appear in the London School of Economics Monograph Series.

58. *Sarawak Museum Project.* Under Mr. Tom Harrisson's direction the socio-economic survey of Malays in Sarawak has made a good start in the Sarawak River Delta, the Rejang River Delta and in the upper reaches of the Samarahan River.

In the Sarawak River Delta three Geography graduates of the University of Malaya have worked with personnel from the Sarawak Museum and natives who have worked with the Museum in the past. A detailed questionnaire and a plan schedule of observations with particular reference to land and river usage was prepared under Professor Dobby's direction in consultation with the Museum. The questionnaire was linked to the census forms of 1947 which contained detailed information on points not covered by the questionnaire and, in addition, selected households were closely observed. The University of Malaya unit has now returned to Singapore and is writing a preliminary report.

In the Rejang River Delta Mr. George Jamuh, a senior member of the Medical Department, was seconded for the Survey. He made an extensive study of the lower Rejang communities with special reference to fishing. A very comprehensive report has been received from Mr. Jamuh and has been checked.

Mr. Harrisson himself was able to make some observations in the upper reaches of the Samarahan River: for example, on the social structure of the nipah sugar producing villages on which the Chinese arrack industry is based, and the effects of a fish scarcity owing to water conditions between Endap and Muara Tuang on the fish-dependent Malays.

The Museum is hoping to start house-to-house work in Kuching with the co-operation of students from Batu Lintang Training Centre and possibly to undertake a study of the relationship between Chinese and Malays in Bau. Work done in the areas already covered would be followed up.

The Survey has benefited from help from the Honourable the Datu Bandar, Mr. J. K. Wilson, the Principal of Batu Lintang Training Centre, Professor Dobby of the University of Malaya and the Honourable Mr. T. P. F. McNiece, President of the Singapore City Council.

59. *Sociological Studies in North Borneo.* Miss Monica Glyn-Jones is still at work on her report on the Dusun of North Borneo. She has broadcast on the subject and has already prepared a draft report on land use.

60. *Sociological Studies in Singapore.* The reports by Mr. Maurice Freedman, now Lecturer at the London School of Economics, and Miss Judith Djamour are in their final stages and should be available shortly.

Mr. Alan Elliott has completed his study of the religious associations of the Singapore Chinese and has submitted it to the Government of Singapore. Attempts are being made to place this study with a publisher.

61. **Psychological research in Malaya.* The Colonial Social Science Research Council recommended that a small grant should be given to Mrs. P. K. Thornton, a postgraduate student at the University of Reading, to enable her to make a study of differences in visual perception between various ethnic groups in Malaya. Mrs. Thornton's work will be supervised by Professor Oldfield. It is hoped that Mrs. Thornton's work, besides being of scientific interest, will be of some practical value to the Malayan Information Services.

62. *Linguistic Research in Fiji, Tonga and Solomons Islands.* Mr. G. B. Milner's Fijian Grammar is in the Press. It will be published by the Government Printer, Suva.

---

* New project started in the year under review.

Caribbean

63. *Social Survey of Jamaica.* The first draft volume of Miss Clarke's report is in the hands of the London School of Economics Supervisory Committee.

Dr. Madeline Kerr's work on Personality and Conflict in Jamaica has been published by the University of Liverpool Press.

64. *Friendly Societies in the West Indies.* A report submitted in 1949 by Mr. A. F. Wells and Mrs. D. Wells has been published in the Colonial Research Publications series together with a despatch from the Secretary of State for the Colonies to West Indian Governors on the subject.

65. *Sociological Research in British Guiana.* Mr. R. T. Smith is just about to finish his field work. An interim study has already been published in the first volume of "Social and Economic Studies" issued by the West Indies Institute of Social and Economic Research. He will return to Cambridge to write up under Professor Fortes' supervision.

Miss Audrey Butt has completed her field work amongst the Arecuna and Akowoio peoples and is now registered for a D.Phil. at the University of Oxford where she will write up the very rich ethnographic and linguistic material collected. She has been awarded a Wenner-Gren Pre-Doctoral Fellowship.

66. *Demographic Survey.* The West Indian volume of the *Demographic Survey of the British Colonial Empire* edited by Dr. B. Long will, it is hoped, issue in June, 1953.

VI. THE STANDING COMMITTEES OF THE COUNCIL

67. The present composition of the Standing Committees is as follows:—

Committee on Anthropology and Sociology

Professor E. E. Evans-Pritchard, M.A.,
University of Oxford (*Chairman*).

Professor Daryll Forde, Ph.D.,
University of London.

R. S. Hudson, Esq., C.M.G.,
Colonial Office.

G. I. Jones, Esq., M.A.,
University of Cambridge.

Professor Margaret Read, C.B.E., M.A., Ph.D.,
University of London.

K. E. Robinson, Esq.,
University of Oxford.

Committee on History and Administration

Professor Vincent Harlow, M.A., D.Litt.,
University of Oxford (*Chairman*).

Professor G. S. Graham, M.A., Ph.D.,
University of London.

H. V. Hodson, Esq., M.A.,
Editor of the "Sunday Times".

F. J. Pedler, Esq.,
United African Company.

Miss Margery Perham, C.B.E., M.A.,
University of Oxford.

K. E. Robinson, Esq.,
University of Oxford.

Douglas Veale, Esq.,
The Registrar, University of Oxford.

Linguistics Committee

Professor Sir Ralph Turner, M.A., M.C., Litt.D., F.B.A.,
University of London (*Chairman*).

Professor J. R. Firth, O.B.E., M.A.,
University of London.

Dr. M. Guthrie, Ph.D., B.Sc.,
University of London.

Dr. Edwin Smith.

Law and Land Tenure Committee

Professor Frank Debenham, O.B.E., M.A.,
University of Cambridge (*Chairman*).

Professor Daryll Forde, Ph.D.,
University of London.

R. S. Hudson, Esq., C.M.G.,
Colonial Office.

Arthur Phillips, Esq., M.A.,
University of London.

Professor M. Postan, M.Sc., M.A.,
University of Cambridge.

Professor S. Vesey Fitz Gerald, M.A., LL.D.,
University of London.

Staff changes in the Colonial Office have necessitated a change in the secretaryship of the Council's Standing Committees and Mr. E. A. C. Bents, Research Department, has been appointed to succeed Mr. E. C. Willis as Secretary.

VII.—PUBLICATIONS BY WORKERS ASSISTED FROM COLONIAL DEVELOPMENT AND WELFARE FUNDS

68. (New publications in the year under review and additions to the list of publications noted in the 8th Annual Report):

Adams, R. S., *A Short study of Reading Problems in the Pacific Islands:* Government Press, Suva. FIER/1, 1953.

The Relationship between Age and Reading Attainment in Fiji Schools: Government Press, Suva. FIER/2, 1953.

The Construction and Standardisation of English Reading Tests for Schools in Fiji: Government Press, Suva. FIER/3, 1953.

Research Survey for 1952: Government Press, Suva. FIER/4, 1953.

Modern-Type Testing in Island Schools: Quarterly. Bulletin of the South Pacific Commission, January, 1953.

Allott, A. N., *A Note on the Ga Law of Succession*: Bulletin of the School of Oriental and African Studies, Vol. XV. 1, 1953.

Anderson, J. N. D., *Recent Developments in Shari'a Law*, "Muslim World", Parts VI–IX, 1952.

Homicide in Islamic Law, Bulletin of the School of Oriental and African Studies, Vol. XIII, 4, 1951.

Barnes, J. A., *African Separatist Churches*, Rhodes–Livingstone Journal, "Human Problems in Central Africa", No. 9, 1949.

Bohannan, Laura. *A Genealogical Charter*, "Africa", Vol. XXII, No. 4, 1952.

Colonial Office, *L'Organization regionale des Recherches Sociales dans les Territoires Coloniaux Britannique*: Bulletin Internationale des Sciences Sociales, Vol. V, No. 1, 1953.

Conference Reports: Compte-Rendu du Seminaire en Anthropologie Sociale tenu a Astrida, 1951 (Conference convened by I.R.S.A.C. of social research workers in East and Central Africa), I.R.S.A.C., Astrida, 1953.

The Present-day Position of Lower Chiefs (Proceedings of Conference of administrators and social research workers convened by East African Institute of Social Research): E.A.I.S.R., Kampala, 1952.

Crowe, Sibyl E., *Politics and Economics in Algeria*: "World Today", February 1948.

France and Morocco: "World Today", March 1948.

Tunisia—A Convalescent Protectorate: "World Today", May 1951.

Cross-Currents in Morocco: "World Today", May 1951.

Articles on Algeria, Tunisia, Morocco, Tangiers, Abd el Krim: Chambers Encyclopaedia, 1953.

Dike, K. O., *African History and Self-Government*, "West Africa", February–March 1953.

Doke, C. M., *Southern Bantu Languages*: "Handbook of African Languages", O.U.P., 1953.

Dowson, Sir Ernest and Shepherd, V. L. O.: *Land Registration*: Colonial Research Publication No. 13, H.M.S.O., 1952.

Epstein, A. L., *The Administration of Justice and the Urban African*: Colonial Research Studies No. 7, 1953.

Forde, D., *Report on Need for Ethnographic and Sociological Research in the Gambia*: Government Printer, Bathurst, 1945.

Gamble, D. P., *Elementary Mandinka Sentence Book*, Secretariat, Bathurst 1951.

Infant Mortality Rates in Rural Areas in the Gambia Protectorate: Journal of Tropical Medicine and Hygiene, Vol. 55, No. 7, July 1952.

Glyn-Jones, M., *A Centenary Ascent (of Mt. Kinabalu)*: Singapore Sunday Times, August 1951.

Gulliver, Philip H., *Jie Marriage:* "African Affairs", Vol. 52, No. 207, 1953.

Huntingford, G. W. B., *The Nandi:* Routledge & Kegan Paul Ltd., 1952.

Kaberry, Phyllis M., *Women of the Grassfields:* Colonial Research Publications No. 14, 1952.

Kerr, Madeline, *Personality and Conflict in Jamaica:* University of Liverpool Press, 1952.

Little, K. L., *Social Change in West Africa:* "Listener", January 1953.

Lloyd, P. C., *Craft Organisation in Yoruba Towns:* "Africa", Vol. XXIII, No. 1, 1953.

Cocoa Politics and the Yoruba Middle Class: "West Africa", January 1953.

McCulloch, Merran, *The Ovimbundu of Angola* in *Ethnographic Survey of West Africa, Part II:* International African Institute, 1952.

Marwick, M. G., *The Kinship Basis of Cewa Social Structure:* "South African Journal of Science", Vol. XVIII, 258–62, 1952.

The Social Context of Cewa Witch Beliefs: "Africa", Vol. XXII, 120–134 and 214–233, 1952.

Mayer, Philip, *Ekeigoroigoro: A Gusii Rite of Passage:* "Man", Vol. LIII, January 1953.

Meek, C. K., *Some Social Aspects of Land Tenure in Africa:* "Land Tenure"—A Special Supplement to the Journal of African Administration, October 1952.

Middleton, J. F. M., *The Kikuyu and Kamba of Kenya* in *Ethnographic Survey of Africa, East Africa:* International African Institute.

Milner, G. B., *South Sea Island:* Common Ground (1951) Ltd., December 1951.

Phillips, Arthur
Mair, Lucy
Harries, Lyndon } *Survey of African Marriage and Family Life:* O.U.P., 1952.

Prins, A. H. J., *East African Age-class Systems:* J. B. Wolters, Groningen, 1953.

Richards, A. I., *East African Conference on Colonial Administration:* Journal of African Administration, Vol. V, No. 2, 1953.

Schwab, Wm. B., *Growth and Conflicts of Religions in a Modern Yoruba Community:* "Zaire", October 1952.

Smith, R. T., *Aspects of Family Organisation in a Negro Coastal Community in British Guiana: Preliminary Report:* "Social and Economic Studies", Vol. 1, 1953.

A Study of a Family in the British West Indies: "Kyk-over-All", Vol. 5, No. 15, 1952.

Smith, M. G., *A Study of Hausa Domestic Economy in Northern Zaria:* "Africa", Vol. XXII, No. 4, 1952.

Turner, V. W., *The Lozi Peoples of Northwestern Rhodesia* in *Ethnographic Survey of Africa, West Africa, Part II:* International African Institute.

Wells, A. F. and D., *Friendly Societies in the West Indies:* Colonial Research Publications, No. 15, 1953.

Wright, N. H., *Notes on English Language Problems in Indian Schools in Fiji:* Government Press, Suva., FIER/5, 1953.

The following items are with the publishers:—

Anderson, J. N. D., *Islamic Law in British Tropical Africa and Aden:* Colonial Research Publications, H.M.S.O.

Bohannan, P. J., *Tiv Farm and Settlement:* Royal Anthropological Institute.

Colson, E., *Social Control and Vengeance among the Plateau Tonga:* "Africa",

Social Structure and the Ancestral Cult among the Plateau Tonga: International Archives for Ethnography,

Clans and the Joking Relationship among the Plateau Tonga: University of California Anthropological Publications.

Dike, K. O., *Trade and Politics in the Niger Delta,* 1830–1885: O.U.P.

Doke, C. M., *The Southern Bantu Languages:* International African Institute.

East African Institute of Social Research, *A Report on Three Years' Work:* EAISR, Kampala.

Epstein, A. L., *The Role of African Courts in Multi-racial Communities:* Rhodes Livingstone Journal "Human Problems in Central Africa", No. 13.

Gamble, D. P., *A Mandinka Reading Book for European Students:* Government Printer, Bathurst.

Geddes, W., *The Land Dyaks of Sarawak:* Colonial Research Studies, H.M.S.O.

Guthrie, M., *Bantu Languages of Equatorial Africa:* International African Institute.

Haswell, M. R., *Economics of a Savannah Village:* Colonial Research Studies, H.M.S.O.

Kuczynski, R. P., ed. Long, B., *Demographic Survey of the British Colonial Empire, Vol. III:* O.U.P.

Morris, H. S., *Report on a Melanau Sago Producing Community:* Colonial Research Studies, H.M.S.O.

Mukwaya, A. B., *Buganda Land Tenure: some present-day tendencies:* EALB.

Richards, A. I. (ed.) *Economic Development & Tribal Change: a study of immigration in Buganda:* W. Heffer & Sons.

Smith, M. G., *Secondary Marriage among the Kagoro and Kadara:* "Africa".

Sofer, C. & R., *Jinja Transformed:* EALB.

T'ien, J. K., *The Chinese of Sarawak:* London School of Economics Monographs.

Turner, V. W., *Lunda Rites and Ceremonies:* Rhodes Livingstone Museum Occ. Papers.

The following typescripts and duplicated reports to the Colonial Social Science Research Council have been deposited in the Colonial Office Library:—

Butt, A. J., Interim Report on an Investigation of the Arecuna and Akowoio of British Guiana, 1952.

Fisher, J. M., Interim Reports on an investigation of the Kikuyu Family, 1953

Harris, A. & G., Interim Report on an Investigation of the Teita of Kenya, 1952.

Smith, M. G., Social Organisation and Economy of Kagoro, 1952.

The Social Structure of the Northern Kadara, 1952.

Stenning, D. J., Interim Report on an Investigation of the Nomadic Fulani of Northern Nigeria, 1952.

Tooth, Geoffrey, Report on the Use of Unadapted Tests of Intelligence, Attainment and Aptitude for the selection of Candidates for Secondary and Technical Education in Nigeria and the Gold Coast, 1953.

APPENDIX I

EAST AFRICAN INSTITUTE OF SOCIAL RESEARCH MAKERERE COLLEGE, KAMPALA, UGANDA

REPORT

April, 1952—March, 1953

Staff

Since the Institute started work in April, 1950, some of the anthropologists and sociologists first appointed completed their initial tour during the year under review. Some of these have terminated their contracts anud others have been on study leave before returning to work. One anthropologist previously holding a Colonial Social Science Research grant during his first tour accepted a post with the Institute for a second tour. Several new appointments have been made and a special feature has been the extension of the field of studies to include the first appointment of a psychologist and an economic historian and there has also been a considerable extension on the linguistic side.

The staff is now as follows:—

Anthropologists and Sociologists

Senior Research Fellows:

Mr. L. A. Fallers
Mr. H. S. Morris
Mrs. P. Reining
Dr. C. Sofer
Dr. A. W. Southall
Dr. E. H. Winter.

Junior Research Fellows:

Mrs. R. Sofer (appointed to senior fellowship on study leave)
Mr. J. W. Tyler.

Research Officers:

Mr. A. B. Mukwaya
Mr. W. P. Tamukedde.

Mr. Fallers completed his first field tour in August, 1952, and left for Chicago University. He has accepted a post at Princeton beginning in October, 1953, but hopes to return for a further period of work at the Institute. Dr. and Mrs. Sofer have been on study leave in England from January to September, 1952, and have resigned on completion of their contract. Mr. Tyler left Uganda in September and has nine months study leave to complete his M.Sc. Dr. Winter, previously holding a Colonial Social Science Research grant, joined the staff in January, 1953, after a period of six months study leave in the United States. A new arrival is Mr. H. S. Morris who started work in October, 1952, to do a study of the Indian community.

Linguists

Senior Research Fellow:

Mr. W. H. Whiteley.

Research Officer:

Mr. E. M. K. Mulira
Mr. O. Bernard—on secondment from Makerere College.

Secretary:

Mrs. K. Kinsleigh.

Mr. Whiteley started work in August, 1952. Mr. E. M. K. Mulira resigned from the staff on completion of his contract in September.

Economists and Economic Historians:

Senior Research Fellow: Mr. C. C. Wrigley.

Mr. Wrigley began work in June, 1952. Funds for the appointment of a senior economist to direct work have been made available on the advice of the Colonial Economic Research Committee and it is hoped to find a suitable candidate during the coming months. Details of a further appointment in the field of economics are referred to in the section on the Kampala survey below.

Psychologist

Senior Research Fellow: Mr. A. J. Laird.

Mr. Laird began work in Uganda in April, 1952, after spending three months in England preparing himself for his research here.

Administration

Administrative Secretary: Miss J. M. Fortt;
Assistant Secretary: Miss G. B. Hunter.

Miss J. M. Fortt also undertook demographic work in connection with the Immigrant Labour Survey and prepared population maps. This material is now being submitted by Miss Fortt as a thesis for an M.A. (London).

Associated Workers

The following research workers have been closely associated with the Institute during the year and attended its conferences:

Holders of Colonial Research Fellowships or Colonial Social Science Research Grants:

P. T. W. Baxter
A. and G. Harris
J. Fisher
B. K. Taylor
G. M. Wilson.

Scarborough grant:

J. Beattie.

Dutch Government and E.A.I.S.R.:

J. H. Scherer.

Fulbright:

W. W. Deshler
H. A. Schneider.

Buildings

The Institute's residential block has been full to capacity and often overfull during the year. With a growing staff and increasing number of research visitors the six flats are already inadequate and some have had to be shared. The Institute's three offices only house one research fellow and two research officers and other research fellows have to work in their own flats.

Fortunately, however, the Government of Uganda responded with great generosity to an appeal for funds for a new building and plans for four new bachelor flats, an adequate library and conference room, four new offices and a director's house have been approved. They will be built on the Institute's present site and the whole group of buildings should have an attractive and dignified appearance.

Library

The Library continues to grow and a special feature has been a considerable addition of books and periodicals on the psychological side, and the collection of workers' fieldnotes. On the other hand no librarian has been available for work and the completion of the Uganda bibliography has therefore had to be stopped.

Finance

Cost of living increases: A major problem during this year has been the continued increase in cost of living allowances given to employees by the Governments of the three territories and by Makerere College to its staff. Such increases on salary scales prove a difficulty for a body with a fixed budget, yet it is virtually impossible for the Institute to refuse cost of living allowances already granted by the College to its staff. In July, 1952, the cost of living allowance rate was raised to 25 per cent. and back dated to 1st January, 1952, and in December it was further raised to 30 per cent. and back dated to 1st August, 1952. This latter rate remains in force.

In April, 1952 a supplementary grant of £1,905 from Colonial Development and Welfare funds was authorised by the Colonial Office towards cost of living allowances in 1952 (Scheme R.409C). The increase to 30 per cent. during the latter half of 1952 has been met by the Institute from savings on salaries.

As a result of the meeting of the Advisory Committee held in June, it was agreed that a further approach should be made to the three territorial governments for grants towards this expenditure until the present scheme for the Institute expires. The Uganda Government has made a grant of £2,900 for this purpose and the Government of Kenya has made a grant of £1,080 towards cost of living allowances during 1953. Tanganyika has not been able to make a contribution for this purpose and this sum remains to be found.

Further additions to Institute funds

Colonial Development and Welfare grants: In July a supplementary grant of £13,167 (Scheme R.409D) was authorised to cover the extension of the original scheme for the finances of the Institute until the expiry of the present C.D. & W. Act, i.e., from 1st July, 1955 to 31st March, 1956. Two further supplementary grants were approved during 1952. These were a grant to meet the cost of a junior economist to work with the Kampala survey team (Scheme R.409E) and a grant for the appointment of a senior economist to the staff of the Institute (Scheme R.409F). These latter grants were made on the recommendation of the Colonial Economic Research Committee.

The Government of Uganda: A grant of £15,000 was made by the Government of Uganda to finance the building of the new block described under Buildings above. Other grants were £2,500 towards the Kampala survey and £500 towards the publication of the Immigrant Labour survey.

The Government of Tanganyika has contributed £250 to the travelling expenses of Mr. J. H. Scherer. The Bukoba Native Authority has contributed a sum to cover three months salary and cost of living allowance for Mrs. Reining during the period she was working on the Bukoba survey.

U.N.E.S.C.O. has contributed £593 for the fertility survey.

Estimates for 1953

The estimates for 1953, submitted for approval through the Colonial Social Science Research Council total £27,803, or £4,127 more than shown in the quinquennial estimates. The increase is mainly due to the payment of cost of living allowances on all salaries.

Advisory Committee

A meeting of the Advisory Committee of the Institute was held in June, 1952 under the chairmanship of the Principal of the College. It was attended by representatives of the three Governments—Mr. K. Cowley (Kenya), Mr. M. G. Lewis (Tanganyika) and Mr. R. G. Gill (Uganda)—and one member of the academic staff, Professor E. R. Holmes.

Work in Progress or Completed

A. *Surveys*

Jinja Survey. Dr. and Mrs. Sofer have completed their first report of the Jinja Survey and it is in the hands of the printer. Dr. C. Sofer has finished a thesis on Race Relations in Industry in Jinja for which he has been awarded the Ph.D. of London University. Mrs. R. Sofer is at work on Changing Forms of the African Family in Jinja and its suburbs. She also is submitting this work for a Ph.D.

Immigrant Labour Survey. The Immigrant Labour report was completed in October, 1952 and is now in the proof stage. (See publications). A short summary of the main findings of the report was circulated fairly widely, i.e. to Administrative Officers, unofficial members of the Legislative Council, members of the Buganda Government and others. By this means the Institute obtained some valuable criticism of its work. Copies of the population maps prepared by Miss Fortt for the report have been sent to the Royal Commission at its request.

Fertility Surveys (Buganda and Bukoba). At the request of Professor Frank Lorimer of the American University, Washington, D.C., who is preparing a document on population trends for U.N.E.S.C.O. (Social Science Division), the Institute undertook to do two intensive surveys of fertility and population trends in two areas in which the sample census had been carried out in 1948. It was intended that these studies should concentrate on the sociological aspects affecting fertility, and for this purpose two low-fertility areas according to the 1948 census were selected. The work was also intended as an experiment in method in relation to the results of the sample census.

In each case the fertility surveys were combined with social and economic surveys carried out in Buganda by Dr. Richards and in Bukoba by Mrs. Reining. In the case of Bukoba the East African Medical Survey co-operated by carrying out a complete medical examination of men, women and children in the selected village, while in Buganda a medical examination of school children and of some adults was also carried out. Agricultural and veterinary surveys were added in each case.

Some of the statistical results were prepared by Mr. C. J. Martin of the East African Statistical Department. A report of the main demographic findings and the sociological factors affecting fertility in the two areas is now complete. A report on each village including the demographic, social, medical, agricultural and veterinary material is proposed and also a joint study on stability of marriage in the two areas.

This survey proved a useful experiment in method and proved the value of a preliminary social and economic study as a basis for subsequent medical, veterinary and agricultural work.

Kampala Survey : African

Dr. Southall started work on the survey in January, 1953 after visiting Nairobi to consult the East African Statistical Department on sampling problems. It is intended that six African "villages" should be surveyed. Three of these are within the boundaries of the municipality of Kampala and three in the environs. The survey is collecting general data on numbers, type of household and family composition, housing, land-tenure, occupation and length of residence, etc. This data should be of value to the local government authorities and town planners. Dr. Southall is also interested in a special study of the new class structure in African society. He is working at the moment with the aid of two African assistants, one man and one woman, but will be assisted from May, 1953 by Mr. P. C. W. Gutkind a second sociologist who will join the work. It is hoped that the results of each small village survey will be handed to the Government in draft form before the completion of the final report.

It is hoped to appoint shortly an economist specially interested in industrial problems to carry out a study of labour-efficiency and labour incentives in the Kampala area and environs. Funds for this post have been provided on the recommendation of the Colonial Economic Research Committee. This economist will work closely with the sociologists when he is appointed.

Kampala Survey : Indian

Mr. H. S. Morris is making a study of the Indian community in Uganda but is studying this community initially at any rate in the Kampala area. He will thus work closely with the rest of the Kampala survey team. Mr. Morris has made a preliminary study of the main groups of Asians living in Kampala and their occupational structure. He is now living with an Indian family in order to study Gujerati. He is particularly interested in the study of family structure in the different Indian communities. He may do a study of housing of the lower income group later in the year.

The Institute has offered to do a survey of one or more African Locations in Nairobi, provided the present disturbed conditions do not make it impossible.

B. *Tribal Studies*

Alur. Dr. Southall presented a thesis on the Alur in May of last year. For this he was awarded the Ph.D. of London University. He had a further six weeks in the West Nile Area on his return here in June and is now completing the manuscript for publication. (See Publications).

Baamba. Dr. E. H. Winter finished his field work on the Baamba in May. He presented his material as a thesis to Harvard University in December and was awarded a Ph.D. Dr. Winter also hopes to publish the results of a series of village surveys done with the local agricultural officer and also to analyse a collection of life histories of the Baamba for publication.

Soga. Mr. L. A. Fallers completed his field work in July, 1952. He hopes to complete a general study of the Soga in June, 1953. In addition he has already completed a manscript on land-tenure and one on the position of lower chiefs.

Zinza. Mr. J. W. Taylor completed his field work in August, 1952. He is completing a monograph on the political and kinship structure of the Zinza.

Haya. Mrs. Reining will complete her field work on the Haya in April, 1953. During the year she has done a survey of methods of appointing chiefs in Buhaya and has taken charge of the fertility survey described above. She has also spent three months in Karagwe in the north of Bukoba district studying political organisation.

Ganda. Material on the social and economic structure of the Ganda has been obtained by means of the Immigrant Labour Survey and the Fertility Surveys described above. A special study of present-day tendencies in Ganda land tenure has been completed by Mr. A. B. Mukwaya and this monograph is in the proof stage. Dr. Richards has continued to work on the political and clan structure of the Ganda. The value of concentrating work in one area is beginning to show itself since material from the Kampala survey, from Mr. Wrigley's study of peasant agriculture (see below) and from Mr. Laird's collection of Ganda autobiographies (see below) are all throwing light on the same society from different points of view.

Some of the associated research workers and especially those doing field work in Uganda have co-operated very closely with the Institute staff and used similar questionnaires. This has extended the range of comparative observation. For instance, Mr. Beattie, Mr. and Mrs. Harris, Mr. Middleton and Mr. Taylor are contributing to the comparative study of political organisation and the study of land tenure mentioned below. Mr. Scherer, who was partly financed by the Institute, has worked almost as a member of its staff.

Further tribal studies are under discussion in the following areas:—Iraqw, Mbulu area, Tanganyika ; Bagishu and neighbouring people in the Eastern Province, Uganda ; one or more of the tribal groups in North Nyanza Province, Kenya.

C. *Linguistics*

Mr. Whiteley spent six months working at the School of Oriental and African Studies before taking up his post with the Institute. He has completed a manuscript on Iraqw—An Introduction to the study of Iraqw—which has been sent to the publishers. He is now making a detailed study of the Kuria language with special reference to the structure of the verb and hopes to present this material for a Ph.D. thesis. Mr. Whiteley accepted the post of Secretary to the Interterritorial Language (Swahili) Committee shortly after arriving at the Institute. The work for the Committee involves editing an annual bulletin, reading manuscripts intended particularly for use in schools as textbooks with a view to granting the Committee's imprimatur on the form of Swahili used, organising such research as is to be carried out and reporting to the annual meeting of the Committee. Mr. Whiteley hopes to do some research on Mombasa and neighbouring dialects of Swahili with Mr. O. Bernard.

D. *Economics*

Mr. Wrigley spent six months on documentary research in the Government Archives at Entebbe on the history of economic policy in Uganda. In November he started village surveys in the Buddu area with special reference to the development of peasant coffee industry. He hopes to work in three other coffee producing areas during the coming months.

E. *Psychology*

Mr. Laird began work in May, 1952, and has completed a study of a small group of Ganda, Luo and Kikuyu students at Makerere College. He collected autobiographies from these students, applied projection and similar tests and tried to gauge each student's perception of himself and others. He is now working on school children in the Maseno area. The initial purpose of this work was to construct and standardise test material suitable for work in tribal areas at a later stage, but the project has developed into a small-scale comparative study of values and attitudes within these different tribal groups.

F. *Comparative Studies*

(*a*) *Political:* The Institute is engaged on a series of comparative studies of political structure. The first of these is a study of the functions and methods of appointment of present-day chiefs. Material has been obtained from Alur, Baamba, Ganda, Ha, Haya, Lugbara, Nyoro, Soga, Teita, Toro and Zinza. It is hoped that this initial monograph edited by Dr. Richards will appear this year, and that others will follow.

(*b*) *Land Tenure:* It is hoped that a joint monograph on land tenure amongst the inter-lacustrine Bantu will also be completed during the coming year. It should contain contributions by Beattie (Nyoro), Fallers (Soga), Mukwaya (Ganda), Reining (Haya) and possibly also Taylor (Toro).

(*c*) *Clan Structure:* A considerable number of clan censuses have been done, and a comparative work on clan structure among the inter-lacustrine Bantu is in progress.

(*d*) *Leadership:* Further discussion on a study of African leadership in the political and economic field has continued, and this project will be put into operation when funds become available.

Publications

East African Studies: The Institute has arranged with the East African Literature Bureau to publish a series of papers dealing with social and economic problems in the East African territories. These may include work by the Institute

staff as well as that contributed by other research workers. The first two volumes in this series will appear shortly: they are "Buganda Land Tenure—some present day tendencies" by A. B. Mukwaya and "Jinja Transformed" by C. & R. Sofer.

Conference Reports. The East African Literature Bureau has also undertaken to produce roneod versions of Conference reports with stiff covers for sale. The first of these will be the Report of the joint IRSAC/EAISR Conference, held in February, 1953.

Monographs. The Institute is also making arrangements for the publication of a series of books. The first of these is "Economic Development and Tribal Change—a Study of Immigrant Labour in Buganda", edited by A. I. Richards and this will be published by W. Heffer shortly. Volumes to follow are: "Alur Society—a Study in Processes and Types of Domination" by A. W. Southall, and "Bwaamba—a Structural Analysis of a Patrilineal Society" by E. H. Winter. It is hoped to follow these with volumes on the Acholi by F. Girling and the Soga by L. A. Fallers.

Conferences

The periodic conferences of the Institute continue to be the basis of its comparative work, and the standard of papers read at these conferences has steadily risen. It seems clear that in the future these conferences will be of two types—informal working parties limited to the members of the Institute in which individual programmes of work and schemes for comparative research are discussed, and agreement on terminologies is reached, and formal conferences in co-operation with outside bodies. During the year under review, an informal working party was held in June, 1952. Plans for the comparative study on political structure were discussed, and the new work proposed by Mr. Wrigley and Mr. Laird.

Third Conference of the Institute

Following this working party, the Institute held its first experiment in joint discussion with Colonial Administrators. The Conference was attended by two representatives from Kenya—Mr. Cowley and Mr. Penwill; four representatives from Tanganyika—Mr. Lewis, Mr. Smith, Mr. Harriss and Mr. Wright; and six representatives from Uganda—Mr. Gill, Mr. Marshall, Mr. Moss, Mr. Oram, Mr. Russell and Mr. Wild. Mr. B. K. Mulyanti represented the Buganda Government. The Institute and its associated research workers were represented by 15 members. The plan of the conference was to have papers read by a District Commissioner and an anthropologist from each of the areas where field work was going on. Bwaamba, Buganda, Busoga, Buhaya, Buzinza and Teita were discussed in this way.

Fourth Conference of the Institute

This conference was the second joint meeting between the social scientists attached to l'Institut de Recherche Scientifique en Afrique Centrale (I.R.S.A.C.) and E.A.I.S.R. It was held at Makerere College in February, 1953. It was attended by 11 anthropologists, 3 linguists, 2 economists and 2 psychologists. Some members of a committee of social experts called by the Council for Scientific Research in Africa South of the Sahara which was meeting at Kampala subsequently, also attended as observers. These observers included Professor M. Griaule, M. le Gouverneur Deschamps, Dr. Clyde Mitchell, Mr. R. H. Sutton, Professor Monica Wilson and Mrs. E. M. Chilver. Professor Franklin Frazier of U.N.E.S.C.O. was a welcome guest. The Conference, which was opened by H. E. The Governor of Uganda, heard reports on the work of I.R.S.A.C. read by Professor L Van den Berghe (Director) and Dr. J. J. Macquet, and on the work of the East African Institute of Social Research by the Director. Papers were read on Survey Techniques, Urban Communities, Value Systems, Land Tenure, African Agriculture and Linguistics.

During the last part of the year it has been possible to hold weekly seminars for those members of the staff living at the Institute.

Contact with Other Bodies

Co-operation with the Government of Uganda continues to be very close, and the Institute is grateful for its continued support and encouragement. The Government of Kenya sent delegates to the conference described above. The Director paid two visits to Nairobi, one in October, 1952 and one in February, 1953, when plans for further work in Kenya were discussed. The Institute has been in close touch with the three Government sociologists in Tanganyika, Mr. H. Cory, Mr. H. Fosbrooke and Mr. A. Wright. It has not been possible for the Director to pay a visit to Tanganyika during this year.

Makerere College

Mr. P. G. Powesland, acting Head of the Department of Social Studies, made a contribution to the Immigrant Labour Report and Mr. C. Ehrlich (Economic Historian) has been doing joint research with Mr. Wrigley on peasant agriculture in Uganda. Mr. J. Goldthorpe (Sociologist) is making a study of the careers of ex-Makerere students which should combine well with the Institute's study of leadership described above. The staff of the Medical School have co-operated over the fertility survey. It is hoped that the Institute will be able to work closely with Professor Fergus Wilson (Agriculture) and Professor Bozman (Public Health) in the future.

Visitors

Apart from the very welcome visit of the Observers at the joint conference in February, mentioned above, the following visited the Institute and gave us help:—

U.K.—Mr. Farrer-Brown (Nuffield Foundation).
Sir Arnold Plant.
Miss Margery Perham.
Mrs. Chilver.
Mr. Kenneth Robinson.

South Africa.—The late Dr. Rheinallt Jones, Director of the Institute of Race Relations.
Dr. Biesheuvel, Director of the South African Institute of Personnel Research.
Dr. Sheila van der Horst, Reader in Economics, Capetown University.

U.S.A.—Dr. Max Yergan on behalf of Ford Foundation.
Mr. Alan Pifer (U.S. Educational Commission, U.K.).
Mr. Robert Matteson (University of Pennsylvania).

The Delegation of Social Scientists from Yale financed by the Carnegie Corporation visited us in June consisting of Professor L. Reynolds, Professor L. W. Doob, Professor J. W. Fesler and Professor K. Pelzer.

Research Visitors. Professor W. E. Diez, Professor of Political Science, Rochester University, New York, arrived here for a year's work on political developments in Buganda and Bunyoro, in November, 1952. It has been possible to accommodate Professor Diez in College or Institute housing, and he has worked very closely with us.

A. I. RICHARDS, *Director.*

APPENDIX II

WEST AFRICAN INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH UNIVERSITY COLLEGE, IBADAN, NIGERIA

REPORT

April, 1952—March, 1953

Staff

Director	Professor W. Hamilton Whyte, M.A. (Leeds)
Administrative Secretary	D. N. Leich, B.A. (Cantab)
Senior Research Fellow in History	K. O. Dike, B.A. (Dun.), M.A. (Aberdeen), Ph.D. (Lond.)
Senior Research Fellow in Statistics	Elizabeth Tanburn, M.B.E., M.Sc. (Lond.), B.A. (Lond.), F.S.S.
Senior Research Fellow in Anthropology	(Vacant)
Senior Research Fellow in Economics	(Vacant)
Research Fellow in Economics	E. K. Hawkins, B.Sc. (Lond.), B.Phil.
Research Fellow in Economics (on secondment from the University of Leeds)	W. T. Newlyn, B.Sc. (Lond.)
Research Fellow in Economics	W. A. Warmington, B.A. (Bristol)
Research Fellow in Authropology	P. Morton Williams, B.Sc. (Lond.)
Research Fellow in History	P. E. H. Hair, M.A. (Cantab)
Research Fellow in Economics	Anne Martin, B.A. (Oxon)
Research Fellow in Anthropology	E. W. Ardener, B.A. (Lond.)
Research Fellow in Economics	(Vacant)
Research Fellow in Economics	(Vacant)
Research Fellow in Anthropology	P. C. Lloyd, M.A. (Oxon)

ATTACHED

Colonial Research Fellow in Anthropology	R. G. Armstrong, M.A. (Oklahoma), Ph.D. (Chicago)
Assistant Research Fellow in Anthropology (C.S.S.R.C.—assisted by C. D. & W. grant)	M. J. Ruel, B.A. (Cantab)

Publications

The most significant achievement of this year has been the acceptance of two manuscripts for publication by the Oxford University Press. One is by Dr. K. O. Dike, Senior Fellow, on "Trade and Politics in the Niger Delta 1830—1885". Dr. Dike had been working on this before he joined the staff but the extension and completion of his book has been made possible by being able to concentrate on research. He is now working on a further publication. The other is by David Rowan who spent two years working on a study of Nigerian Banking. Mr. W. T. Newlyn who is joining the staff of the Institute in September has made a similar study in East Africa and the two authors have collaborated. These publications should be available early in 1954, and will represent a valuable addition to the literature of the country. Mr. Peter Lloyd has completed a dissertation on "A Comparative Study of Political Institutions in Some Yoruba

Kingdoms". This has been accepted for the degree of B.Sc. in Anthropology by the University of Oxford. On the advice of the examiners it is being revised for publication. It is encouraging to have our first manuscripts accepted by such distinguished publishers and there is reason to hope that they will be the first of a continuous series of West African Studies.

The Colonial Office Film Unit completed its experiment in the use of the film as an educational factor with rural audiences. Mr. Morton Williams, Research Fellow (Anthropology) who was seconded to this team has written the report on this experiment for the Colonial Office.

Research in Operation

Economic and Social Survey of the British Cameroons: This has been undertaken by request of the Cameroons Development Corporation. Professor J. Henry Richardson of the University of Leeds has assisted in drawing up the plan and will be responsible for the final report. The field work is being done by Mr. Ardener and Mr. Ruel, Anthropologists, and Mr. Warmington, Economist. The scheme is comprehensive and will include an analysis of the labour force employed and an examination of their tribal and biological background.

Palm Oil Production: This pilot study by Miss Martin is making good progress. It is an enquiry into present methods of production and the standard of living of the farmer. It is being carried out in the Eastern Region with the active co-operation and help of the Department of Agriculture. It is intended as a preliminary to a larger scheme contemplated by the Marketing Board.

Enugu Coal Mining Community: Mr. Hair is continuing his study into the social background and history of the miners employed who with their families represent an African population of over 40,000. He has had first-hand experience of coal mining in England and made a special study of the social background and history of the British miner. While the setting is very different in Nigeria the author has the equipment and interest to carry out this task.

Local Government in two Yoruba Towns: Mr. Lloyd has commenced a study with three years' experience of this area and the towns selected. The enquiry has aroused interest amongst the Administrative Officers and should throw light on the effect of the rapid changes now taking place in local government throughout Nigeria.

Cost of Living Index and Analysis of Cocoa Statistics: Miss Tanburn has been taking part in the Cost of Living Surveys now being undertaken by the Statistics Department of the Nigerian Government. She is also engaged on an analysis of statistical data collected by the Government of the Gold Coast on the Cocoa Industry.

Analysis of the Structure of Foreign Trade: Mr. Hawkins is researching in this field with special reference to the values of imports and exports and the terms of trade. The International Bank's representatives who recently visited Nigeria have asked that the results of this investigation might be made available to them.

Survey of Historical Records: This is one of the most important tasks undertaken by Dr. Dike, Senior Fellow. Dr. Dike has now completed a report outlining an archives policy and the setting up of a Public Records Office. Accompanying the Report is a guide giving a list of the documents which have been examined and placed in temporary files. It is very impressive reading. These reports have been submitted to the Governor for consideration by the Council of Ministers. The cost of the Survey is being borne by the Nigerian Government.

In addition to the projects at present in operation there are certain schemes which have not yet been started on account of shortage of staff. A comprehensive Economic Survey of Northern Nigeria with special reference to the Groundnut and Cotton Industries has been held up because it has not yet been found possible to find a Chief Executive Officer with the necessary qualifications and experience. The Institute has been asked by the Marketing Boards to recruit staff for this

purpose and to be responsible for organising the scheme. It is also intended to initiate social surveys in selected towns both in Nigeria and the Gold Coast.

Conferences

At the Institute's headquarters at Ibadan last March delegates came from the Gold Coast and from the field in Nigeria to attend a conference on the central theme "The Impact of Industrialism on African Communities". Dr. K. A. Busia brought a strong contingent with him and Professor M. J. Herskovits of Northwestern University was also present for part of the Session. In April at Achimota, economists from the Institute and from the Nigerian Government together with a representative from Fourah Bay College assembled at Achimota for a conference with members of the Social Science Departments of the University College there. Professor Gaston Leduc, Professor in the Economics of Overseas Territories of the University of Paris, was present at the Seminar and contributed a paper; Dr. W. O. Brown, Consultant to the Board of Overseas Training and Research, Ford Foundation, New York N.Y., was also present.

Full reports of both these conferences are being published in limited editions of 500 copies for distribution in West Africa, the United Kingdom and the United States. These reports will include all the papers read at the conferences.

West African Inter-Territorial Secretariat

As the result of discussions between the Director and their representatives, grants have been made towards the current costs of the Institute by the Nigerian and the Gold Coast Governments of approximately £2,000 p.a. each for four years.

The Director was invited to attend a meeting of the Secretariat at Lagos on June 17th. His Excellency the Governor welcomed the members and thereafter the Hon. Okoi Arikpo, Minister of Lands, Survey, Local Development and Communications, was elected Chairman for the remainder of the proceedings. One of the chief functions of the Secretariat is to receive reports and consider the work of the Institutes of Research in West Africa. Three Ministers from Nigeria, two from the Gold Coast, one from Sierra Leone and the Gambia, and the Directors of five Institutes were present: Col. Milligan—Trypanosomiasis, Mr. J. West—Cocoa, Mr. D. Rhind—Agriculture, Mr. B. W. Tovey—Palm Oil, and Professor W. Hamilton Whyte—W.A.I.S.E.R. A brief report of the Institute had been circulated before the meeting. This aroused considerable interest and warm appreciation was expressed for the progress made during the last two years. After discussion it was suggested that a small consultative Committee might be set up composed of the Governors from the four territories, and Ministers and their senior officials, the Principals af the three Colleges at Ibadan, Achimota and Fourah Bay. The proposal was welcomed by the Director and a motion to set up such a committee was approved. This meeting of the Secretariat is a useful medium of informing Governments concerning the research activities of the Institute and should be an effective means of obtaining their support. The Ministers present were impressed and surprised that so much was being achieved at so small an annual cost.

Co-operation with the Gold Coast

Professor Williams is acting as representative of the Institute in the Gold Coast. Arrangements have been made for the recruitment of staff. Professor Williams as Head of the Department of Economics and Dr. Busia, Head of the Department of Sociology, in collaboration with the Director will be responsible for recruiting staff through the machinery of the London Committee. With the aid of the Government grant from the Gold Coast it will be possible to make up to three appointments and steps are being taken to fill these posts. The Institute is now well established in the Gold Coast and the conferences held at Achimota have strengthened the friendly co-operation between the members of the Institute staff and their colleagues on the Social Science Staff of the University College of the Gold Coast. A plan of research is being drawn up for the Gold Coast and provision for building up a research library.

Staffing

I should like to emphasise the importance of staffing in relation to the future of the Institute since I believe its success depends upon the quality and suitability of its staff. Powerful forces operate to deter the recruitment of first-class European staff and at present the supply of African staff is inadequate. Under these circumstances there is a danger of accepting inferior candidates rather than hold up the work. This would be a grave mistake. Our policy has been to attract young graduates with first class degrees by offering attractive research prospects. But I am anxious to secure the help of senior staff with experience in research at present on the staff of European Universities, for short periods. The process will take time but there is no reason why it should not succeed in view of the unique opportunities for research in West Africa.

The accumulation of historical records is already arousing interest amongst experts in the United Kingdom who have suggested the possibility of writing a standard history of West Africa. In October of this year Mr. W. T. Newlyn from the Economics Department of the University of Leeds is arriving in Nigeria to study certain problems of West African trade. His appointment is for one year and may be extended if necessary. He is the author of certain publications dealing with East Africa and wishes to extend his knowledge to West Africa. This has been arranged through the kind co-operation of the Vice-Chancellor and Professor of Economics at Leeds and I trust other Universities in the United Kingdom will follow their example. In the long run, however, the best results will only be achieved by African scholars who know the country, its traditions and culture. The present situation is a challenge to young Africans with the intellectual capacity for this work.

Long-Term Plans

It is impossible to submit a detailed plan of research for a long period but financial provision must be made for the recruitment of staff who will settle in the country and undertake research of a more fundamental character. In at least four fields is such research urgently needed, e.g., History, Economics, Sociology and Law. The major purpose in all four is to make available in permanent form a record of the literature and culture of West Africa. History offers an immediate opportunity in the records now being surveyed. In Economics there is material for the study of a comparison between an advanced and undeveloped economy. I can think of no more exciting task than to rewrite the "Wealth of Nations" against the background of West Africa. In Sociology there is everything the social anthropologist could hope for in the ancient rites and customs, the endless variety of tribes and languages and the impact of modern industrialism on these communities. In Law there is the same variety of material. Different religions and rites; the feudalism of the North and the political changes in the South and East; the complexity of land tenure and family rites. Such comments indicate the vital role which Social and Economic Research should play in the future.

But long-term programmes are only possible by the provision of financial resources. The present organisation has made a promising start but there is no security beyond 1956. To make provision for the future some form of endowment is essential. This is not a serious financial burden and it would pay handsome dividends in the future. The capital expenditure incurred when the Institute was set up has been met by the British taxpayer. It is only the current costs that have to be provided for. With a staff of 20 this would mean an annual outlay of not more than £43,000. If that were shared between the West African Governments the Institute would be no longer dependent on Colonial Development and Welfare Funds, though there is every prospect that the British Government will renew this grant. Endowment therefore means a guaranteed annual grant of £43,000 for the future. This would provide the security necessary to recruit staff and plan research for indefinite periods. With such security the Institute could make a real contribution to the future progress and welfare of West Africa.

W. HAMILTON WHYTE, *Director.*

APPENDIX III

RHODES-LIVINGSTONE INSTITUTE

REPORT

April, 1952 to March, 1953

Buildings

In November, 1952, the Institute's headquarters were moved from Livingstone to the new buildings near Lusaka. The office block, consisting of library, offices, and research rooms, and the Director's house, the Administrative Secretary's house, and six African staff houses are now occupied. The building programme should be completed by September, 1953, when it is expected that the official opening will take place.

Staff

All appointments under the Omnibus Research Scheme have now been filled except two—those of the Senior Sociologist for the Copperbelt and of the Demographer. Since no suitable candidate was available to take over the work, Dr. J. C. Mitchell, now Director of the Institute, continued the statistical part of the Copperbelt study which he had started as Senior Sociologist. On the completion of this part of the work in December, 1952, he moved to the Institute's headquarters. In March, 1953, he went to the United Kingdom for a six months' writing-up period.

Mr. Watson and Mr. van Velsen arrived in their field areas in June, 1953, after making a short preliminary trip to Kaonde country.

Mr. A. L. Epstein, who has been appointed to the post of lawyer, arrived in Northern Rhodesia in December, 1952. Mr. Epstein graduated in law at Queen's University, Belfast, and was later called to the English Bar. He became interested in social anthropology and spent a year studying that subject at the London School of Economics before coming to Northern Rhodesia in 1950 under a Colonial Social Science Research Council Studentship to make a study of urban courts. Subsequently he was appointed Research Assistant in the Department of Social Anthropology, University of Manchester.

The post of Second Sociologist was filled in January, 1953, by Miss E. M. Richardson. Miss Richardson graduated in Botany at London University and has held research posts at the Lister Institute and in the Human Nutrition Research Unit. She worked on the Nutritional and Social Survey of the Gambia and also on the Social and Economic Survey of Sierra Leone.

The candidate whom the Trustees had selected for the post of Administrative Secretary, following Miss Hyam's resignation, was unable to take up duties because of illness. Mrs. P. Robinson acted as temporary Administrative Secretary from February, 1952 until August, 1952, and carried out her duties conscientiously and efficiently. In September, 1952, Miss M. McCulloch was appointed to the post and took up duties in Livingstone. Miss McCulloch, a graduate of the University of New Zealand, studied social anthropology at the London School of Economics and subsequently worked as Research Assistant at the International African Institute, London.

Work in Progress

Social Surveys of the five Copperbelt towns and of Livingstone have been completed, and a survey of Broken Hill commenced. Before leaving the Copperbelt the team of African Research Assistants made family budget studies in Chingola and Mufulira. Mr. S. C. Katilungu has been appointed Senior African Research Assistant, but the second post of Senior African Research Assistant is now vacant following the resignation of Mr. Mukonoweshuro. All six Junior African Research Assistants have now been appointed.

Mr. Turner, who has been in the United Kingdom making a preliminary writing-up of his material on the Lunda of Mwinilunga, will return to the field

in April, 1953, to commence his second field tour. His paper on "Lunda Rites and Ceremonies" will be published shortly as a Rhodes-Livingstone Museum Occasional Paper. During his second tour Mr. Turner will continue his study of Lunda ritual and mystical beliefs, and will collect material on the historical development of the political institutions of the Lunda-Lovale group.

Mr. Gann returned to the United Kingdom in September, 1952, and has now completed his contract with the Institute. His report on historical development in Central Africa will be presented as a thesis at Oxford in June, 1952, and will later be published by the Institute.

Mr. Watson has been engaged in a study of the Mambwe people, and has collected interesting material on clan and political structure. Mr. van Velsen is at work among the Lakeside Tonga of Nyasaland; his report will probably be orientated around the social and economic results of the high rate of labour migration in the area. Both Mr. Watson and Mr. van Velsen are expected to leave the field in October, 1953, to write up their preliminary reports.

Miss Richardson will make family studies, combined with nutritional surveys, on the Copperbelt, while Mr. Epstein will make in the same area a study of urban native administration. Both are at present in the Bemba tribal area becoming familiar with the linguistics and social background of the main tribe represented on the Copperbelt, and will move to the line of rail in about July or August, 1953.

The research work sponsored by the Institute in Southern Rhodesia will come to an end in August, 1953, when Mr. Hughes' contract expires. Now that his fieldwork period has ended, Mr. Hughes is in Bulawayo writing up his material on the Ndebele.

Conferences

A conference was held in January, 1953, at the Institute's new headquarters. All research officers attended except Mr. V. W. Turner, who was still in the United Kingdom. Miss Richardson had not been appointed at the time. In addition to Institute staff, the conference was attended by Professor and Dr. Hilda Kuper from Natal University, Mr. Gordon Gibson from Chicago University, and Mrs. Elizabeth Munger, whose husband is at present doing sociological research in Southern Rhodesia.

The next conference is to be held in September, 1953, and is to take as its theme the various aspects of labour migration.

Publications

The Institute's second major publication, *Shona Customary Law*, by Hans Holleman, appeared in the second half of 1952 and had a good reception. Mr. Cunnison's paper *History on the Luapula* (Paper No. 21) also appeared. No journals were published during 1952-53, but it is expected that four journals and four papers, in addition to Mr. Barnes' book *Politics in a Changing Society*, will appear during 1953-54.

J. C. MITCHELL,
Director.

APPENDIX IV

INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH UNIVERSITY COLLEGE OF THE WEST INDIES

REPORT

April 1, 1952—March 31, 1953

The Institute of Social and Economic Research has been set up to initiate and conduct research in the social sciences in the Caribbean area. Its aims are three-fold. Its first objective, which emphasises its close connection with the University College is to assemble material as a basis for the teaching of the social sciences. Its second objective is to conduct research into the application of the principles of

social science to the particular problems of the area and so to help on the formulation and administration of social and economic policy. The Institute also bears in mind as a third objective that the study of the complex, evolving social and economic patterns of the Caribbean may throw light on fundamental principles of the social sciences.

Its headquarters is at the University College of the West Indies, Jamaica. The Institute is set up as an integral part of the University College but is financed from an independent grant of Colonial Development and Welfare funds; some workers are normally absent from headquarters in order to conduct research in other territories in the British Caribbean. The members of the research staff are:

Research Staff

Director—H. D. Huggins.
Research Fellow—M. G. Smith.
Junior Research Fellow—L. Braithwaite.
Junior Research Fellow—G. E. Cumper.
Junior Research Fellow—N. M. Siffleet.
Junior Research Fellow—K. H. Straw.
Junior Research Fellow—W. F. Maunder.

Three members of the research staff were appointed to the Institute in August, 1949, but only one was in Jamaica at that time and the other two arrived in the Caribbean at the end of the year. In the year 1949-50 four major projects were planned and begun: the Director's study of seasonal variations and economic development in Jamaica, Braithwaite's study of community structure in Trinidad, G. E. Cumper's study of labour and general productivity in Jamaica and N. M. Siffleet's estimation of national incomes in the Leeward and Windward Islands and in Barbados. In the year 1950-51 two more major projects were begun: K. Straw's survey of consumption patterns in Barbados and E. Campbell's study of training methods in a number of Kingston Factories. These, with M. G. Smith's study of West Indian social structures and W. F. Maunder's project on transportation in Jamaica, both begun in the year 1952-53, represent the main projects on which the Institute's research staff have up to the present been engaged.

It will be clear from the timing of these studies that in the period from 1949-50 to the present the development of the Institute has been dominated by the policy decision to begin with major studies. This decision in effect set aside the period 1949-50 to 1952 as a preliminary phase in the Institute's life. During this phase the members of the Institute have published little at an academic level, and it has therefore not been easy to make an assessment of the progress of the organisation. The progress made has however been important. During this period the individual members of the staff have gained in experience of research under West Indian conditions. The Institute has built up its research reference library and statistical services and has worked out procedures of collaboration and criticism among the staff. In summary, the Institute has grown from a number of individual workers into a functioning research group. As such it is now in a position to produce work of a standard that shows the influence of the maturing and integration of the team.

The original decision to engage in long-term studies envisaged that in the present year a number of major studies would come to fruition, each of which would have had the advantage of thorough discussion and criticism by the full staff of the Institute. All the projects begun in the years 1949-51 have now in fact reached the stage of final preparation for publication, and one, the Director's study of the development of secondary industries in Jamaica, has been published.

As a medium for the publication of some of the work of the Institute a journal, "Social and Economic Studies," has appeared, the first number in February, 1953. In addition the Institute's staff will be encouraged to submit papers for publication in other learned journals in the field. If the costs of publication permit, it is intended to include contributions from workers both in the Caribbean and abroad. The Journal can also serve usefully for exchange purposes and as a means of increasing the range of materials sent to the Institute's library.

This outline indicates the stage in the growth of the Institute which has now been reached. In the year 1952-53 the results of the plans made in the period 1949-50 have begun to appear. Publications of the studies then planned will continue into 1953-54. The quality of such publication is the greatest single test of the success of a research organisation of this type and it would clearly be improper at this stage to allow an annual report to anticipate the event in this respect. A more detailed account of the different aspects of the Institute's work in 1952-53 follows. The inception of the publication programme stands out, as the most significant advance made by the Institute in the year.

RESEARCH PROGRAMME: INSTITUTE STAFF

During the year 1952-53 the staff of the Institute have been engaged on the projects indicated below.

Economics

Employment, Development and Incentive Financing (Jamaica): *H. D. Huggins*—A report on this study was published in "Social and Economic Studies," February, 1953. Examination was made of the employment situation in Jamaica and of the long term economic trends which make necessary some form of stimulation of agricultural and industrial development. A suggested programme of incentive financing to bring about an expansion of manufacturing industry in the island is outlined.

Seasonal Variation and Employment in Jamaica: *H. D. Huggins*—An examination of the seasonal fluctuation in certain indices of economic activity in Jamaica. A report will be published in a forthcoming issue of "Social and Economic Studies."

National Income Estimates: *N. M. Siffleet*—The collection of field data for this study was substantially completed by the beginning of the year under review. A preliminary report was prepared and revised after consultation with Miss Phyllis Deane, who visited the Institute early in 1952. Later in 1952 draft reports on Antigua, Barbados, Dominica, Grenada and St. Kitts were circulated for comment by persons with specialist knowledge of the field of work and of the territories. Revisions based on these criticisms are now being incorporated in the final report, to be published in the latter half of 1953. The paper will thus give national income estimates for Barbados, the Windward Islands and the territories of the Leewards with the exception of Montserrat and the Virgin Islands, and will also consider some of the methodological problems raised by the study. Shorter papers on the St. Kitts-Nevis inter-relationship are being prepared for publication shortly after the main report.

Productivity and Selective Industrialisation: *G. E. Cumper*—A paper has been published in "Social and Economic Studies," February, 1953, on the implications of some statistical material on value added per worker and capital employed per worker in Jamaican manufacturing industries when a choice has to be made between the introduction of different types of industry into an economy of the Jamaican type.

Two Studies in Jamaican Productivity: *G. E. Cumper.*—A report on these studies will be published in a forthcoming issue of "Social and Economic Studies". The contents of the two studies are: (*a*) an examination of the relative output per worker in certain industries in Jamaica, the United Kingdom and the United States, and of the significance of the results obtained; (*b*) an investigation of some social factors in labour productivity variations, based on field studies on two Jamaican sugar estates, and of the possible implications of the results for labour policy in the sugar industry. Reports on both of these studies were in draft stage in late 1952, but have been extensively revised since that time. Some historical material on the Jamaican sugar industry originally intended as a historical introduction to (*b*) has been set aside for incorporation into a study of the economic history of the industry in Jamaica with special reference to changes in productivity since emancipation.

Industrial Training Methods and Techniques in Kingston, Jamaica: E. Campbell.—This project was designed to study the policies, procedures and methods developed by managements in twenty-five Kingston factories for the purpose of building up a labour force to carry out production processes. The information on which it is based was obtained from interviews with managerial personnel and to a less extent with trained workers, trainees and union representatives; on visits to production departments, and observation of working situations; and on statistical data extracted from factory records. The report on the study was brought to the draft stage in 1952 and is now being revised for publication.

Patterns of Income and Consumption in Barbados: K. H. Straw.—This study is based on two field surveys which collected information on the income and expenditure of a sample of families in the seasons of highest and lowest economic activity in Barbados. The surveys were completed in the summer of 1952. An interim analysis of the survey material was made and a report prepared which is now being revised for publication under the title "Some preliminary results of a survey of income and consumption patterns in a sample of households in Barbados". A more thorough processing of the data was carried out by the Dominion Bureau of Statistics, Ottawa, and will form the basis for a fuller analysis of income and consumption patterns. This study has been carried out in close collaboration with the Government of Barbados and the information it provided has been used in designing a new Index of Retail Prices for the island. The field questionnaires contain much information on subjects not included in the main object of the surveys and short papers will later be prepared on these subjects—for example, underemployment, unemployment and family structure.

Certain Economic and Social Aspects of Jamaican Transport: W. F. Maunder.—This study, begun late in 1952, is designed to cover three aspects of inland transportation in Jamaica—a brief historical survey of the development of modern transport facilities, an estimation of gross island expenditure on inland transport for the year 1950–51 and an analysis of the results of a passenger movement survey made recently in Kingston in connection with the public bus service.

Mr. Maunder was also in charge of the Institute's statistical section and gave advice on the statistical aspects of a number of projects undertaken by the research staff and by other departments of the University College.

Sociology and Social Anthropology

Social Structure in Trinidad: L. Braithwaite.—The aim of this study is to examine the institutions of two racially distinct village communities in Trinidad and to show the function of these institutions in the context of the social system of the island. The first aspect of the project called for field studies in a Negro and an East Indian village. These were completed in the autumn of 1952, together with a draft account of the work in the first village. The work since that date has consisted in the elaboration of a suitable scheme by means of which the available material on the total social system of Trinidad and its component communities and institutions could be organised and the society's functional relationships made clear. A draft report on this aspect of the study has now been prepared and has been profoundly influenced by Professor Talcott Parsons, who visited the Institute early in 1953.

A comparative Study of West Indian Social Structures: M. G. Smith.—The aim of this study is to establish types of West Indian social structure; the working method is to make intensive investigations of a small number of societies of contrasting types and to attempt to assess the role of economic and historical factors in their structural differentiation. Field work in Grenada was begun in November, 1952. As a general foundation for the historical aspect of the study a paper "Aspects of Social Structure in the British Caribbean circa 1820" has been prepared, based on published accounts of that period.

Reassessment of Research Programme

The work done and the experience gained in the last three years has led to a reassessment of the Institute's future programme, and a statement has been prepared which sets out the general lines of future research and draws attention to particular areas in which present knowledge of the social and economic situation of the West Indies is deficient.

Associates and Visitors

The Institute has served as headquarters for a number of workers whose research in the area has been conducted in association with the Institute, and for visitors to the Caribbean with research and teaching interests in the social sciences.

In the Institute's annual report for 1951–52 mention was made of two social anthropoligical studies in British Guiana which have been undertaken in association with the Institute. One has been conducted by Miss Audrey Butt under the direction of Professor Evans-Pritchard. She has now completed a period of field work among the Arecuna and Akowoio and has returned to England to complete and organise her material. The second study has been carried out by Raymond T. Smith under the direction of Professor Fortes. Mr. Smith is about to complete his field work in a coastal village community. An interim report by him on the nature of the family in this community has appeared in "Social and Economic Studies", February, 1953. Mr. E. P. Seaga, an associate of the Institute, has begun work in a Jamaican village; his study is designed to interpret in the terms of social psychology the social processes of growth from infancy to adulthood in a Jamaican rural community.

Mr. David T. Edwards, who is formally associated with the Institute on a Ministry of Agriculture scholarship, has worked on a study designed to assess possible future lines of development for the Yallahs Valley Land Authority, Jamaica. His work is based on census and survey data for the Yallahs Valley.

Mr. Eric James worked at the Institute's headquarters on a study of "Administrative Institutions and Cultural Change in Jamaica, B.W.I.", under the direction of Dr. William J. Ronan of New York University.

The stage now reached in the research programme makes visitors particularly welcome. Among those who visited the Institute in 1952–53 were:—Professor Talcott Parsons, Mr. J. M. Stycos, Sir Thomas Lloyd, Sir George Seel, Mr. L. Farrer-Brown, Dr. J. R. Raeburn, Mr. Adenola Igun, Miss Phyllis Deane, Mr. G. W. P. Roberts, Mr. A. G. Haldane, Mr. J. A. Bough of United Nations.

Particular mention should be made of the visit of Professor Talcott Parsons, made possible through a grant from the Carnegie Corporation, and of the visit of Miss Phyllis Deane. Both spent some time at the Institute and discussed critically and constructively the research programme of the Institute. In the case of Miss Deane she was able to visit Trinidad and to discuss the Institute's programme in the Eastern Caribbean.

Internal Organisation

The growth of the Institute's staff, its research programme and its contacts with the public and the initiation of publication of its own Journal have meant a steady increase in the work of administration. The statistical section has been reorganised, and its equipment improved, and it has been placed under the charge of Mr. W. F. Maunder, who joined the research staff as economic statistician in the autumn of 1952

The Institute has now built up a library with some 40,000 catalogue references. This collection on social science subjects is of the more specialised type that would be of primary use in a research programme. Special attention is given to the collection of material, not easily available elsewhere, on the economy and society of the West Indies, including particularly locally issued official reports and memoranda. The first of these objectives has proved much easier to attain than

the second, which has depended on the gradual establishment of relations of confidence with governments and other agencies in the other West Indian territories. During 1952-53 this second type of material has begun to come in in more satisfactory quantities and the balance between local and general material originally planned is coming closer to attainment. The Institute works in regard to its general system on the broad lines agreed upon with the University College Librarian.

Relations with the Community

It is not in the nature of the Institute's work that it should bring wide and continuous contact with the general public. At the same time the Institute has an obligation to build up certain specialised types of relationships which can be mutually advantageous. In the year 1952-53 the policy has been continued of making the Institute available as a forum for informal discussion by a group of persons, including public servants, with a specialised interest in the social sciences. The same group of persons have given generously their advice and criticism on the Institute's own research projects. Such activity, which is influential out of all proportion to the numbers of the public involved, rests on the Institute's position as an independent and impartial body which is nevertheless keenly interested in current problems.

During the year the Institute, through its staff, participated in some specific assignments and some of these are included in the following:—

(*a*) The Institute was asked: to undertake a study, with the use of a survey, of the Yallahs Valley Development area, Jamaica; to undertake a general study of land utilisation of Jamaica; to plan a survey of the public transportation services in the chief urban area in Jamaica for the Jamaica Transport Board; to undertake for the bauxite interests a study under the general direction of the Institute.

(*b*) The Director was invited to serve: by the Government of Jamaica on the Workers' Panel of the Labour Department for purposes of arbitration, under the Public Utility Undertakings and Public Services Arbitration Law, Boots and Shoes Industry, 1952; by the Government of Jamaica as Arbitrator (Chairman) on a Board of Enquiry into the wage dispute between Messrs. Marples, Ridgway & Partners and the Bustamente Industrial Trade Union, 1952; as an observer by the Caribbean Commission West Indian Conference (Fifth Session) in Montego Bay, 1952; as Chairman of the Preparatory Committee on Education and Sociology by the Caribbean Commission Research Committee in Trinidad, 1953; as a representative of the University College at the Fifth Inter-American Conference of Municipal History in the Dominican Republic; as a member of the Advisory Committee in Extra Mural Studies in Jamaica; as a member of the Board of Management of Excelsior School.

(*c*) In addition, various members of the Institute's staff have been asked and have undertaken special assignments. Thus Mr. Straw has served on a committee to advise the Barbados Government on cost of living procedure. Mr. Cumper, Mr. Maunder, Mr. Braithwaite, Miss Siffleet, Mrs. Campbell, Mr. Edwards, Mr. James have participated in lectures for the Extra Mural Department, or for the West Indies Social Welfare Training Course, or for the Co-operative Credit Union. Mr. Maunder served on a Committee to advise on various aspects of the sample census of population being planned by the Bureau of Statistics, Jamaica.

The establishment of the Institute's journal, "Social and Economic Studies" opens up the possibility of an important type of relationship with a wider public. One issue of this journal has appeared in February, 1953, and has attracted press comment throughout the British Caribbean. It is anticipated that in the year 1953-54 the staff and associates of the Institute will present for publication eight major reports of studies, all of which have a bearing on contemporary Caribbean problems.

Up to the present the Institute's public relations programme has been informal. At the end of the year under review consideration was being given to a reorganisation of the various means of contact with the Institute's public—discussions, seminars and public lectures by distinguished visitors and by the research staff—into an organised programme adapted to the needs of the phase of development into which the Institute has now entered.

H. D. HUGGINS,
Director.

April, 1953.

APPENDIX V

EDUCATIONAL RESEARCH INSTITUTE FOR FIJI AND THE WESTERN PACIFIC TERRITORIES

REPORT FOR 1952

Staff, Buildings and Equipment

The Educational Research Institute for Fiji and the Western Pacific Territories was established at Suva in the Fiji Islands in January, 1952. It was intended to serve all the British colonial territories in the Western Pacific; it is hoped that its work may ultimately be of benefit to all the native peoples of the Pacific.

The staff consisted of the Director of the Institute, Mr. R. S. Adam, who is a member of the British Colonial Education Service with a number of years' experience in the Pacific Islands, together with a Fijian Research Assistant, an Indian Research Assistant, and clerical assistance.

Until almost the end of 1952, the staff worked in offices rented in a business house in Suva. The Institute was then removed to a building specially designed and built for it by the Fiji Public Works Department. The new building consists of five offices with a verandah and car-garage. Being quiet, cool and well-lit, these offices are most suitable for research work. A house has also been built for the head of the Institute: other quarters are under construction.

Suitable furniture and equipment was purchased, and a small reference library was founded (at the end of the year, 48 volumes had been acquired), largely of specialised research reports and statistical textbooks. A small collection of educational magazines has also been acquired by gift or purchase from overseas research centres. It is hoped that the numbers of books and periodicals will be greatly increased in the coming months, these items being essential tools of research.

Finance

The United Kingdom assisted in the foundation of the Research Institute with a grant of £23,000 from its Colonial Development and Welfare Research Fund. The Fiji Development Budget for 1952 estimated approximately £4,000 for current expenses (chiefly personal emoluments) and £12,800 for capital expenditure during the year. Current expenses have been a little less than the estimate.

General Research Needs of the Islands

Anthropologists and sociologists have conducted many investigations in the Pacific Islands, but there have been very few projects concerned with education. Some educational research results from England and America are applicable in the Pacific area; others are so remote from island conditions that it would be less difficult to perform the whole study again in island schools than to adapt the original work.

Unfortunately there is no way of knowing with any certainty how far results from a particular investigation overseas would apply to the islands. How near, for example, would the word-lists of Burt or Thorndike be to the English vocabulary of native children? Each would need to be checked carefully with island results before any reliance could be placed upon them.

The situation facing the staff of the Educational Research Institute was therefore composed of a considerable body of overseas research results which may

or may not apply to local conditions, and a number of special local problems not covered by any foreign workers. It was immediately obvious that a research team could play a direct and useful role in an educational system which as yet possessed none of the aids for many years considered essential in European countries. Apart from the pioneer researches of Cecil Mann in intelligence and attainment, no intelligence or aptitude tests, no diagnostic tests, and no scientific estimates of the effectiveness of teaching methods.

First Research Projects

As a starting point, the Director of Education in Fiji chose a study of problems associated with selection for secondary education. Because this would involve the preparation of attainment tests, consideration of tests of general ability, and other practical projects, it was regarded as a most useful theme for the first years of the Institute's work.

It was decided that the first project would be the standardization of tests of attainment in the basic subject for schools in Fiji. Careful consideration was given to the whole question of attainment testing in island schools, and a summary of conclusions reached is set out below.

The Purpose and Value of Testing

Workers in all fields of science depend on measurement. The effectiveness of a scientific instrument cannot be estimated without accurate measurement. No invention or discovery, whether it be in medicine or physics, sociology or education, is useful unless the changes which it brings about can be observed against a recognised scale.

For centuries education used subjective measurements. A pupil's performance was weighed against the teacher's memory of other performances in other days and other years. But memory grows dim, and even when refreshed by written records, it fails to recreate exactly the performance from the numerical estimate. Hence comparisons were inevitably inexact and measurements irregular.

The advent in the twentieth century of modern-type objective testing largely eliminated the personal element from records of performances. Accurate comparison from year to year, or school to school, were possible. Thus a new branch of education—scientific measurement—was opened.

A school test is essentially a way of procuring reliable evidence about the degree to which pupils have reached the desired objectives of education. Most subjects set several objectives; hence a good test must provide evidence of the degree to which pupils are nearing each of these objectives. In such cases, evidence on only one objective is inadequate.

In the construction of tests, it has been found easier to discover the extent to which children have learned facts than to determine the interests and attitudes which they have acquired. For this reason, the testing of facts has long since left behind other branches of testing, and has thus distorted the whole science of educational measurement. Teachers have readily accepted the testing of facts, and ignored other branches. Consequently there have been many critics of the effect which testing is having on the schools in increasing the ascendency which fact-learning, even under ordinary circumstances, tends to establish in weak schools.

The remedy does not lie in discarding the instrument because it may be misused. The surgeon does not throw away his scalpels because children may cut themselves: he tries to prevent these accidents. Similarly although sometimes misused, educational testing is an essential instrument. It is for teacher-training colleges to teach its correct use.

Testing in the Islands

Each educational system in the Pacific has developed its own arrangements for testing. These vary with the stage of development of the system as a whole. The British Solomon Islands, for example, being in an early stage of educational development, has done little general attainment testing of any kind. The Fiji Group has tests for general selection purposes and for teachers' promotion. None has been standardized. About seventeen years ago Mr. C. W. Mann carried out useful experimental work in intelligence testing in Fiji.

Other authorities have compiled tests as the need arose for them, chiefly for selection. Very few have as yet produced comprehensive measuring instruments of the type so readily available in Europe and the United States which, besides indicating levels of attainment, are also diagnostic. Nor has there been any comparison between different groups which might discover the existence of special local factors retarding general educational progress or advancement in a particular branch of learning.

Some systems could already use tests intended to be placed in the hands of the teacher. Others require only tests to be used by the authority in the area, and by research workers seeking new curricula and improved teaching methods.

Uses for Tests in Island Schools

There are five main uses for tests in schools in the islands. They are:

(i) The formation of class standards, and promotion from class to class.
(ii) Selection for secondary and tertiary education.
(iii) The readjustment of curricula and timetables.
(iv) Study of teaching methods.
(v) Provision of textbooks.

These various uses will be discussed separately.

(i) Standardized attainment tests are necessary for the formation of class standards and for promotion from class to class. Most island schools are extremely fluid in their class arrangements. Children seldom make steady progress through a graded curriculum. Some linger for years at a particular level, others leap grades with astonishing speed.

These irregular movements usually have their origin in the head teacher's convenience at the time, but are also due to carelessness and ignorance. Standardized tests provide a firm guide for him in his promotion arrangements. They also give the local authority a simple means of checking on these arrangements.

(ii) The most popular used of standardized tests is in selection. No island education system has reached the stage of being able to offer secondary or tertiary education to all who desire it. In many cases selection is one from several hundreds of candidates. This makes the task of selection a difficult and unenviable one. The administrator who rejects 199 candidates for a place in a secondary school in favour of a candidate who proves a complete failure is open to severe criticism from others as well as from his own conscience, even though this can happen under the best selection process yet devised.

To give maximum assistance in selection, tests are necessary not only at the selection level, but for several preceding years. Besides attainment tests, tests of general ability, verbal ability and personality can help to prevent mistakes. Selection at the tertiary level is less difficult than selection for secondary education. There is a longer school record to consider, and attainment is of much greater importance at this stage.

(iii) All undeveloped systems of education make constant readjustments of curricula and timetables. The first stage of organization (which the Solomon Islands, for example, is just approaching) is the publication of a general curriculum for schools in the area. The next stage, some years later (which Fiji has just passed), is to issue a more definite curriculum incorporating revisions which seem desirable after some years of working with the earlier programmes. Revisions normally follow after this at longer intervals, until the prescribed courses of study are changed finally into general suggestions which head-teachers adapt to suit their own particular schools (as in England at present).

At all stages of development it is helpful to be able to see exactly how much of a prescribed curriculum is being used in the schools, and what results it is producing. This may be judged roughly by personal observation, but clear, tabulated results are only possible with standard tests.

(iv) Many teachers have made valuable discoveries about methods of adapting overseas teaching methods to island schools, but unfortunately the opportunity

to test these ideas thoroughly and pass them on to others has seldom arisen. The scientific testing of teaching methods requires accurate measuring instruments. Provision of these instruments would expedite research in this direction.

(v) Provision of text-books is a problem now being studied in most island territories. Word frequency tables (derived from test material) are essential guides to language difficulty and vocabulary standards. Before the composition of a text, testing will indicate content needs; after composition it will evaluate the text.

Earlier Research

Some research studies had already been completed by Mr. R. S. Adam before the establishment of the Research Institute. These investigated the range of English vocabulary of the Indian, Fijian and other non-European students in the schools. They proved a useful foundation for the composition of reading tests by the Institute staff, and were a valuable aid in studying reading problems.

Detailed Plans for First Projects

For selection purposes, standardized tests for classes III and IV in schools in Fiji would probably have been sufficient. It was decided, however, to prepare tests for all classes from II to VIII so that data would be available for the study of curriculum assimilation and teaching method.

Tests in English and Arithmetic were obviously essential, and Social Studies was added to provide fuller information about general academic levels. Because reliable information about attainment standards in particular schools was not available, it was decided to use a large sample. If possible, about 20 per cent. of the whole school population would be tested. In February, work on the tests began.

Testing

Construction and Standardization of the Tests. Tests were prepared in English Reading Comprehension, Arithmetic and Social Studies. Alternative forms were prepared in all cases so that in later years administrators could change the matter of the tests without altering levels and upsetting standardization figures.

The tests in Social Studies were of the modern "short-answer" type, each containing about fifty questions. It was felt that the considerable amount of work required in preparing these was merited by their objectivity and ease of marking. This factor would also increase their later value in schools.

Trial Administration of the Tests. It was necessary before a full programme of testing was begun to experiment with each test to ensure that it would standardize at a central figure to give a good spread of results on either side. A test showing an average result, for example, of 20 per cent., would give an inadequate spread on the lower end of the scale. A sample of 1,400 children was therefore selected for this preliminary testing.

To secure a good sample of this size, it was necessary for the staff to visit many schools in different districts. Limited travel facilities tend to make visits to schools in the Colony a slow and difficult process.

Eliki Seru travelled by sea through the scattered Lau Islands, visiting schools and testing children. Shankar Lal travelled by road from Suva to the Indian schools in the Lautoka area. All members of the staff travelled along the coastal roads from Suva, visiting schools and giving tests. In all, about 5,000 tests were administered in less than three months, and the papers were brought back to the Institute office, marked and filed.

Results of the Trial Testing. When the results had been tabulated and analysed, it was found that only slight adjustment was necessary in the English and Arithmetic tests before these were ready for standardization. The Social Studies papers proved more difficult. Results were too low for good standardization, and an investigation of the reasons for this was initiated.

Two hundred children were tested orally and individually to discover the effects of the type of Social Studies test used, one which was new to Children in Fiji. (Results of this work will be published under the title, "The Use of Modern-Type Testing in Island Schools".)

Then the teachers of the classes concerned were themselves tested over the same material, to discover whether their lack of information was the chief reason for the low standard. After examination of all these results, it was decided that it was not possible to proceed at that time with an attempt to standardize the Social Studies test. A report was made to the Director of Education in Fiji setting out results and suggesting certain changes to improve teaching method in the subject.

General Administration of the Tests. To effect a full standardization of the other tests, they were administered to more than 7,000 children in about 70 schools in many different parts of the Fiji Islands. The Director of the Institute made a 400-mile trip by car, visiting schools in Viti Levu. Both Research Assistants also travelled extensively on this main island of the group. In addition, the Indian Research Assistant travelled 250 miles by air to the island of Vanua Levu to test Indian children living in that area, and the Fijian Research Assistant went by boat to the island of Tavenuni to test in Fijian schools. Altogether it is estimated that the research team covered more than 4,000 miles, often over very difficult country, in the course of its work during 1952.

The office work involved in the testing programme was also extensive. With about 20,000 separate test papers coming into the Institute office to be marked and filed, and results tabulated and analysed, careful and efficient organization was needed to avoid chaos.

The whole programme of preliminary testing, full testing, marking and filing was completed in ten months, in addition to several minor projects which are described later in this report.

Research Reports and Other Publications

Test Material. The tests of attainment in English and Arithmetic prepared by the Research Institute were published and have been passed to the Director of Education in Fiji for general use in his administration. The English tests were also made available to the Director of Education in Papua and New Guinea at his request for use in selection. Enquiries are being made to find whether they may be useful in other Pacific territories.

Experimental work has been initiated in conjunction with research officers in Papua and the Gold Coast in connection with testing, and copies of Fiji tests have been sent to these areas for experimental testing.

Attainment in English Reading. A report was prepared for publication describing the construction and standardization of the tests of English reading comprehension. Results were shown and special features of the results were noted.

The effect of the location of the school in relation to large towns was assessed. It was noted that town schools secured higher scores than country schools. Sex differences were also checked and the scores of girls were observed to be higher than those of boys. Correlations were made between records of success in vernacular reading tests and scores in the English reading tests. A moderately high degree of correlation was observed.

The Relationship between Age and Reading Attainment. On the basis of the results from the English tests, an investigation was made of the relationship between age and reading attainment among non-European children in the Fiji Islands. As is usual in undeveloped areas, the age range in each school class in Fiji is very wide. This presented an excellent opportunity for a thorough study of the age-attainment relationship.

By tabulating mean scores for various age groups regardless of their class level, it was possible to estimate the optimum reading commencement age as being between seven years and seven years and six months for children in Fiji schools. The period of greatest progress in reading was found to be between ten and twelve years.

Scores were organized to show the performance of age groups within each class. Younger children appeared to be at a disadvantage throughout. The middle age groups were consistently superior, while the older children after starting poorly recovered in later classes.

Comparison between Indian and Fijian scores showed the former children developing earlier but losing their lead at adolescence. Girls scored better than boys at all ages. There was no significant difference in reading development in relation to age between town and country children.

The effect of age on attainment in social studies and arithmetic was calculated and compared with that in English reading. No relationship could be seen in arithmetic, but results in social studies revealed a similar development to that in reading.

Reading Problems in the Pacific Islands. The results of the standardized tests of English reading were also used in an investigation of adult reading in villages in Fiji. This aimed at discovering the rate of progress or regression in reading ability of village people after they left school. It also examined the extent and type of their reading activities in normal village life. This information was expected to prove useful not only in education at the adult level but also for its implications for school training in reading.

Results of this study, as shown in a report prepared for publication, suggest that increased maturity offsets lack of practice in English reading among village people. Within a limited range, the number of years since school had no effect on reading skill. All those tested were partially literate in English.

Surveys of the type and extent of adult reading showed that Fijians read religious literature and newspapers in the vernacular, but that less than half the people regularly read anything in English. Most houses contain a small amount of Fijian literature and none in English. Preference in English was for short simplified books. Comics failed to attract readers.

Stages of reading ability were described and the position of Pacific peoples on this scale was considered. Possible values of reading skill to island races were discussed. Methods by which reading ability in the area might be increased were outlined. A mass literacy campaign combined with the provision of ample suitable literature was favoured

Conclusion.

The first year of a research organization is seldom fruitful. Buildings and equipment must be secured, staff appointed and organized into a working unit, and projects selected and planned. This Research Institute has been fortunate enough to overcome these first difficulties and settle down quickly.

At the end of its first year it stands not only fully prepared for its work, but well launched on important projects. The completion of standardized tests is a major achievement, and the studies which have already emerged from them, and those which are foreshadowed, contribute materially to knowledge of the factors involved in school instruction in the basic subjects in this area.

The attainment tests will be the chief part of the Institute's work on selection. They will take their place as the main instrument of attainment measurement in the Fiji group, and will thus provide the basis for all changes in the selection arrangements. The second factor in selection, the estimation of general ability through an intelligence test, remains as a problem for the Institute in the coming year.

To conclude this Survey, it may be said that the Educational Research Institute has not only made good preparation for its work, but is already fulfilling its intended function in providing professional and administrative assistance to the progress of education in the area which it serves.

R. S. ADAM,
Principal

Colonial Medical Research Committee Eighth Annual Report (1952-1953)

Medical Research Council,
38, Old Queen Street,
S.W.1.
3rd July, 1953.

SIR,

On behalf of the Colonial Medical Research Committee, I have the honour to transmit to you the Eighth Annual Report of the Committee, covering the period 1st April, 1952, to 31st March, 1953.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) H. P. HIMSWORTH,
(*Chairman*).

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL MEDICAL RESEARCH COMMITTEE

SIR HAROLD HIMSWORTH, K.C.B., M.D., LL.D., F.R.C.P., Q.H.P., Secretary, Medical Research Council (*Chairman*).

BRIGADIER J. S. K. BOYD, O.B.E., M.D., D.P.H., D.T.M. & H., F.R.C.P., F.R.S. (late R.A.M.C.), Director, Wellcome Laboratories of Tropical Medicine.

PROFESSOR P. A. BUXTON, C.M.G., F.R.S., Professor of Medical Entomology, University of London.

MAJOR-GENERAL SIR GORDON COVELL, C.I.E., M.D., D.P.H., D.T.M. & H., Director, Ministry of Health Malaria Laboratory, Horton Hospital.

SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S., Senior Physician, Hospital for Tropical Diseases, University College Hospital.

PROFESSOR A. C. FRAZER, M.D., D.Sc., Ph.D., F.R.C.P., Professor of Pharmacology, University of Birmingham.

PROFESSOR P. C. C. GARNHAM, M.D., D.P.H., Professor of Medical Protozoology, University of London.

PROFESSOR R. M. GORDON, O.B.E., M.D., Sc.D., F.R.C.P., D.P.H., D.T.M., Professor of Entomology and Parasitology, Liverpool School of Tropical Medicine, University of Liverpool.

DR. F. HAWKING, D.M., D.T.M., M.R.C.P., National Institute for Medical Research.

SIR WILSON JAMESON, G.B.E., K.C.B., M.D., F.R.C.P., D.P.H., formerly Medical Adviser to the Secretary of State for the Colonies, and Chief Medical Officer of the Ministry of Health and Ministry of Education.

PROFESSOR G. MACDONALD, C.M.G., M.D., M.R.C.P., D.P.H., D.T.M., Professor of Tropical Hygiene, University of London, and Director, Ross Institute of Tropical Hygiene.

PROFESSOR B. G. MAEGRAITH, M.B., B.Sc., D.Phil., M.R.C.P., Professor of Tropical Medicine, University of Liverpool.

PROFESSOR B. S. PLATT, C.M.G., M.Sc., Ph.D., M.B., Professor of Human Nutrition, University of London.

SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., M.B., Chief Medical Officer to the Secretary of State for the Colonies.

DR. R. LEWTHWAITE, O.B.E., D.M., F.R.C.P., Colonial Office.

MAJOR-GENERAL SIR JOHN TAYLOR, C.I.E., D.S.O., M.D. LL.D., D.P.H. (I.M.S. Retd.), Medical Research Council.

Joint Secretaries.

Terms of Reference

The terms of reference of the Committee are to advise the Secretary of State for the Colonies and the Medical Research Council on all matters of medical research in and for the benefit of the Colonies.

SUB-COMMITTEES

MALARIA

BRIGADIER J. S. K. BOYD, O.B.E., M.D., F.R.C.P., F.R.S. (*Chairman*).

PROFESSOR P. A. BUXTON, C.M.G., F.R.S.

MAJOR-GENERAL SIR GORDON COVELL, C.I.E., M.D., D.P.H., D.T.M. & H.

SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S.

DR. F. HAWKING, D.M., D.T.M., M.R.C.P.

DR. R. LEWTHWAITE, O.B.E., D.M., F.R.C.P.

PROFESSOR G. MACDONALD, C.M.G., M.D., M.R.C.P., D.P.H., D.T.M.

PROFESSOR B. G. MAEGRAITH, M.B., B.Sc., D.Phil., M.R.C.P.

SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., M.B., B.S.

MAJOR-GENERAL SIR JOHN TAYLOR, C.I.E., D.S.O., M.D., LL.D., D.P.H. (I.M.S. retd.) (*Secretary*).

HELMINTHIASIS

PROFESSOR R. M. GORDON, O.B.E., M.D., Sc.D., F.R.C.P., D.P.H., D.T.M. (*Chairman*).

BRIGADIER J. S. K. BOYD, O.B.E., M.D., F.R.C.P., F.R.S.

PROFESSOR J. J. C. BUCKLEY, D.Sc., Professor of Helminthology, University of London.

SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S.

DR. F. HAWKING, D.M., D.T.M., M.R.C.P.

DR. R. LEWTHWAITE, O.B.E., D.M., F.R.C.P.

DR. W. E. KERSHAW, V.R.D., M.D., D.T.M. & H., Lecturer in Medical Parasitology, Liverpool School of Tropical Medicine, University of Liverpool.

SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., M.B., B.S.

DR. J. WALKER, D.Sc., Ph.D., D.Phil., National Institute for Medical Research.

MAJOR-GENERAL SIR JOHN TAYLOR, C.I.E., D.S.O., M.D., LL.D., D.P.H. (I.M.S. retd.) (*Secretary*).

EAST AFRICAN MEDICAL SURVEY

PROFESSOR G. MACDONALD, C.M.G., M.D., M.R.C.P. (*Chairman*).

BRIGADIER J. S. K. BOYD, O.B.E., M.D., F.R.C.P., F.R.S.

PROFESSOR P. A. BUXTON, C.M.G., F.R.S.

DR. F. HAWKING, D.M., D.T.M., M.R.C.P.

DR. R. LEWTHWAITE, O.B.E., D.M., F.R.C.P.

PROFESSOR B. S. PLATT, C.M.G., M.Sc., Ph.D., M.B., Ch.B.

MAJOR-GENERAL SIR JOHN TAYLOR, C.I.E., D.S.O., M.D., LL.D., D.P.H. (I.M.S. retd.).

MR. R. E. RADFORD, Colonial Office (*Secretary*).

PERSONNEL

PROFESSOR G. MACDONALD, C.M.G., M.D., M.R.C.P., D.P.H., D.T.M. (*Chairman*).

Dr. F. H. K. GREEN, C.B.E., M.D., F.R.C.P., Assistant Secretary, Medical Research Council.

SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., M.B., B.S.

MAJOR-GENERAL SIR JOHN TAYLOR, C.I.E., D.S.O., M.D., LL.D., D.P.H. (I.M.S. retd.).

DR. R. LEWTHWAITE, O.B.E., D.M., F.R.C.P. (*Secretary*).

COLONIAL MEDICAL RESEARCH COMMITTEE
EIGHTH ANNUAL REPORT

CONTENTS

COLONIAL MEDICAL RESEARCH COMMITTEE

EIGHTH ANNUAL REPORT

GENERAL

1. Fourteen meetings of the Committee and its Sub-Committees were held during the year.

2. Colonel H. E. Shortt retired from the Malaria Sub-Committee. Dr. W. E. Kershaw was appointed a member of the Helminthiasis Sub-Committee. During the year it was decided to dissolve the East African Medical Survey Sub-Committee, which had become largely redundant on the establishment of the regional East African Standing Advisory Committee for Medical Research.

3. It is gratifying to record the conferment of the honour of Knight Commander of the Order of St. Michael and St. George on Dr. E. D. Pridie.

4. In addition to the reports from the research units under the scientific supervision of the Committee summaries are included of medical investigations made by research units or organizations that are wholly supported by the Governments of British Colonial Territories or Mandated Territories. Other summaries are contributed by investigators deputed to work in those territories by research organizations based in the United Kingdom or the United States of America, and supported financially wholly or in part by them. For continuity of context some are placed immediately after kindred reports that are the scientific responsibility of the Committee.

COLONIAL RESEARCH SERVICE

5. The Personal Sub-Committee continued to make general recommendations from time to time concerning appointments to this service, and to interview new applicants for the Service. It reviewed a number of transfers to it, together with the terms of service, that were proposed by the Governments of Colonial Territories; and made recommendations to the Secretary of State accordingly.

WORK OF THE COMMITTEE

General

6. All the principal research projects that were in progress during the previous year have continued. Five vacancies were filled, one by a Colonial Medical Research Student on completion of his specialized training. Two Students completed their two-year course of training, one in virology in Melbourne, the other in helminthology at the London School of Tropical Medicine and Hygiene and later in the Gambia prior to joining the Loiasis Research Unit in the Cameroons. Two other Students are undergoing training in entomology and helminthiasis respectively at the above-mentioned School of Tropical Medicine. Another, newly appointed, will study under Dr. F. Hawking at the National Institute for Medical Research, Mill Hill, London.

Development of Research Schemes

7. Of the twenty-one Research Schemes under the scientific supervision of the Committee at the beginning of the year under review, one, for the study of malaria in North Borneo and Sarawak, has since been concluded. Another, for the study of leprosy in Malaya, is in abeyance owing to the retirement of the officer-in-charge. A research project for the study of viruses in the Caribbean region, following an approach to the Colonial Office by the International Health Division of the Rockefeller Foundation, was welcomed by the Committee, and initiated by the Foundation in Trinidad, with the co-operation of the government of that territory, which made available a suitable site and buildings that could be appropriately adapted as laboratories. Dr. Wilbur S. Downs and Dr. Charles Anderson, of the Foundation, are in local charge of the project; British personnel will be added as suitable scientists become available. The Committee also considered specific proposals from the Government of the Federation of Malaya for an investigation of filariasis, which is a serious focal problem in certain regions in Malaya. The proposals, which advocated the investigation of measures of control by mass treatment with Hetrazan and house-spraying with DDT by a field unit of the Institute for Medical Research, Kuala Lumpur, were commended; and the Committee recommended to the Colonial Office that a financial grant for a three-year period be allocated to the project from the research funds provided under the Colonial Development and Welfare Acts. The proposals were favourably considered also by the Colonial Insecticides Committee, which recommended a similar matching grant.

Finance

8. The Committee has reviewed from time to time the allocations of research monies made to the various research projects. In relation to the scientific progress made, and the competing claims of new proposals, appropriate adjustments have been made. In spite of constantly rising costs and a fixed ceiling of the funds originally available, it has proved possible to retain a certain reserve against the possible need to initiate urgent new schemes without jeopardising the progress of current schemes.

Overseas Visits

9. Ten members of the Committee and Sub-Committees visited various units in the field. Professor A. C. Frazer, Professor P. C. C. Garnham and Dr. R. Lewthwaite spent five weeks in discussions with the seven units in East Africa. Professor R. M. Gordon and Dr. W. E. Kershaw participated for some time in the work of the Loiasis Research Unit at Kumba in the British Mandated Cameroons; and Professor Platt and Dr. Hawking, in the work of the Field Research Station at Fajara in the Gambia. Major-General Sir Gordon Covell visited units in East and West Africa, Professor B. G. Maegraith some of those in West Africa, and Sir Neil Hamilton Fairley discussed on the spot the malaria investigations proceeding at the Institute for Medical Research at Kuala Lumpur, Malaya.

10. The facilities of the overseas research units have again been much used by specialist workers from the United Kingdom for the short-term study of specific problems; a development which the Committee seeks increasingly to foster. In addition to the participation in overseas research projects, noted above, by certain members of the Committee, special studies were undertaken by other scientists from British universities. Thus Professor Heller, Dr. Schneider and Mr. Blackmore, of the Department of Pharmacology, Bristol University, spent some three months in Uganda studying the

water metabolism of mal-nourished children and adults, utilising the resources of the Physiological Research Unit at Kampala that is directed by Professor Eric Holmes, whose Unit also gave facilities to Dr. R. F. A. Dean and Miss Schwartz, of the Medical Research Council and the Department of Experimental Medicine at Cambridge, in a study of other aspects of infantile malnutrition. Dr. N. A. Barnicot, Reader in Physical Authropology in the University of London, again spent many months in specialised studies with the Hot Climate Physiology Research Unit in Nigeria. At the same Unit Dr. M. L. Thomson, Senior Lecturer in the Department of Physiology, London School of Hygiene and Tropical Medicine, spent four months on secondment in a comparative study of the functioning of sweat glands of African and European subjects in a tropical environment. Dr. D. S. Bertram, Reader in Entomology at the same London School, worked for three months in the Gambia, based on the Field Research Station of the Medical Research Council at Fajara, where he initiated studies of the entomological background of filaria infestation and of the efficacy of gammexane against the anthropophilic mosquitoes of that territory. Also in the Gambia, at the same Research Station, Dr. W. Minning, Lecturer in Helminthology at the Tropeninstitut at Hamburg, undertook for six months a special investigation of serological aspects of filariasis and other worm infestations at the Medical Research Council's Field Research Station in the Gambia.

REGIONAL ORGANISATION OF MEDICAL RESEARCH IN COLONIAL TERRITORIES

East Africa

(a) *East African Bureau of Research in Medicine and Hygiene*

(b) *East African Standing Advisory Committee for Medical Research*

11. The Bureau, established in Nairobi in 1949, is directed by Dr. K. A. T. Martin, who is also the Secretary to the Standing Advisory Committee for Medical Research in East Africa, on the advice of which more appropriate terms of reference were given to the Bureau. In addition to providing a link between the inter-territorial medical research organisations and the East Africa High Commission, the Bureau advised the High Commission on health research projects and undertook administrative and other work concerned with medical research in the territories. It kept in touch with institutions and individuals conducting medical research and maintained co-operation between them, and arranged facilities for visiting research workers. Information on current research was exchanged between the Bureau and the Secretaries of the Colonial Medical Research Committee and also with other scientific centres, so that a clear appreciation was gained of the research being done in a wide field. The Director visited the various medical research units in East Africa, and also attended the Colonial Office Conference of Directors of Medical Services held at Oxford, at which research was discussed. Of administrative and consultative work, the main emphasis centred on new proposals for leprosy research, for research on the effects of malaria on people living in hyperendemic areas, and for the renewal of the East African Malaria Unit on an expanded basis.

12. The formation of the Standing Advisory Committee, the inception and functions of which were noted in last year's Report, was an important step in the advancement of medical research in East Africa. The Committee,

which is advisory to the East Africa High Commission, has received the following terms of reference: "to advise on the needs for medical research in Kenya, Uganda, Tanganyika and Zanzibar; to advise on the means for ensuring that the results of research are applied in practice; and to keep under review the facilities for interterritorial collaboration in medical research." With the Administrator of the East Africa High Commission as Chairman, it is composed as follows: The Directors of Medical Services of each territory, or their representatives; two representatives appointed by the Colonial Medical Research Committee; two representatives appointed by the Council of Makerere College; two further members, being persons associated with medical research, appointed by the East Africa High Commission with the concurrence of the Secretary of State; the Director of Colonial Medical Research.

13. In 1952 two meetings of the Committee were held, the first in Nairobi in March, the second in London in July, The third meeting was held in Nairobi in January, 1953. It was followed by a very successful three-day Scientific Conference, organised by Dr. Martin and held in Nairobi under the chairmanship of Professor A. C. Frazer, to which experts in nutrition, infectious diseases, school health and sociology contributed. It is intended that a Conference on similar comprehensive medical subjects will follow each meeting of the Standing Advisory Committee, to be held yearly in alternate territories.

Under the agreed procedure, copies of the Minutes and relevant papers of the Committee were supplied to the Colonial Medical Research Committee for their observations where applicable, and the Minutes were also supplied to the East African Governments. The Committee reviewed the work of the medical research organisations, considered the future scope and direction of research in East Africa, and put forward several relevant proposals. It recommended the continuance of all the existing High Commission medical research organisations, with the exception of the Filariasis Research Unit; other recommendations were made in regard to the Colonial Research Service. The new research projects mentioned earlier and another concerned with paediatric research were supported. The need for statistical and demographic studies in relation to research was the subject of a special discussion at the third meeting, and its importance emphasised. The activities of the Committee are reported in more detail in the Annual Report of the Bureau for 1952.

West Africa

14. In West Africa, in pursuance of the recommendations of the inaugural meeting of the Standing Advisory Committee, held last year, and with the approval of the West African Inter-Territorial Conference which met at Accra in July, 1952, steps are being taken to transform the Standing Advisory Committee into an appropriately enlarged West African Council for Medical Research. A Bill to give statutory powers to this Council has been drafted and is under consideration, and it is hoped that it will be enacted during 1953. With a considerable measure of autonomy this Council will have under its supervision the Virus Research Institute at Yaba, to be renamed the West African Council for Medical Research Laboratories, the Hot Climate Physiology Research Unit at Oshodi, the Leprosy Research Unit at Uzuakoli, and the Loiasis Research Unit at Kumba; and will develop additional research in malaria, yaws and tuberculosis.

REVIEW OF THE WORK IN PROGRESS

East African Medical Survey

15. The activities of this medical survey unit, the objectives and methods of which were outlined in last year's report, have continued in the four selected areas there noted; and have been essentially at this stage fact-finding in the field of public health. As such they have considerably added to the potential of the existing territorial medical cadres in the selected areas. Outstanding staff vacancies were filled during the year. The Unit is now a compact and active medical group with ample housing and laboratory facilities.

In the Bukoba area of Tanganyika the measures organised by the Survey to reduce the high incidence of venereal disease, with funds, equipment and senior staff provided by the Local Authority, continue in operation. Statistical analysis of data relating to the incidence of malaria, hookworm and relapsing fever is in hand. The problems of ill-health defined by the Survey will be for the local health department to resolve.

16. On Ukara Island, which has thirteen villages scattered around its shores, the Entomologist is undertaking a study of snails from various parts of the island in a search for the host or hosts of schistosoma species. He is also making a comprehensive entomological survey. The assessment of the prevalent diseases at Kisii, in Kenya, the area most recently chosen for survey, will continue for another nine or ten months, in order that two successive seasons may be covered. Here a special investigation of the value of four drugs in the treatment of onchocerciasis in all stages and ages is in progress. Vaccination with B.C.G. is proceeding in the schools of this area; and the comparative merits of the intra-dermal and multiple pressure techniques are being studied. As many as possible of those children who prove to be tuberculin-positive are referred to the territorial radiologist at Kisumu for X-ray examination. It is intended that those suspected thereby to have lesions will be referred to the Government hospital for further examination, and treatment if necessary.

17. In the Kwimba District of Sukumaland, Tanganyika, interesting observations of the incidence of schistosomiasis in different ages of both sexes were made. In the schools an incidence of 95 per cent. was found, that decreased with increase in age-group. Contrary to local belief no diminution in mental alertness was apparent in the infected as compared with the uninfected.

Completion of the new laboratory is expected by the middle of 1953. This commodious three-storey building has been designed to serve both the large volume of routine examinations desired by the units in the field, and research problems that these may uncover. There is every prospect that, in addition, it will afford ample space for special research projects by investigators from the United Kingdom or elsewhere, which from time to time, on the advice of the East African Standing Advisory Committee for Medical Research, the High Commission may institute.

Publication

LAURIE, W.—(1953) "Annual Report of the East African Medical Survey Unit for 1952." *East Africa High Commission, Nairobi.*

Helminthiasis

(a) *Loiasis Research in the Cameroons*

18. There have been no changes in the permanent staff of the Loiasis Research Scheme at Kumba, Cameroons, the unit having been under the control of Mr. W. Crewe, the entomologist, and Mr. P. J. Moore, the laboratory superintendent. Visits were paid by Professor R. M. Gordon, Dr. W. E. Kershaw and Mr. W. L. Nicholas of the Liverpool School of Tropical Medicine, and by Dr. C. A. Hopkins of Glasgow University, all of whom took part in different aspects of the work. Professor B. G. Maegraith of the Liverpool School of Tropical Medicine also paid a short visit whilst on a tour of West Africa on behalf of the Nuffield Foundation, and valuable assistance was given by Mr. R. W. Cartman of the Cameroons Medical Field Unit.

19. *L. loa and its transmission by Chrysops.* Continued work on the breeding of larvae, and on the flies of the forest canopy, has brought to light two new species of *Chrysops,* three species not previously known in West Africa, and three previously known only as the prey of wasps in the Congo. Four of these species have been caught as adults in the forest canopy, but it is very unlikely that any of the rarer species will prove of importance in the transmission of human disease. Details of the development and migration of *L. loa* in *C. silacea* have not been fully elucidated, and work on these problems is proceeding. The biting mechanism of *Chrysops* and the deposition of the infective stage of *L. loa* have been studied, together with the early stages of penetration of the filarial larvae into the tissues of the final host. During the last year, some of the intermediate larval stages of *Chrysops* and other tabanids have been identified, and many of the pupae of the different species have been correlated with the adult forms. No male flies have yet been caught, and information is still lacking on mating and oviposition.

20. *A. perstans and its transmission by Culicoides.* It has been shown beyond reasonable doubt that *C. austeni* is a vector of *A. perstans* in the area; the role of *C. grahamii,* however, is still not clear. Two other species, *C. inornatipennis* and *C. fulvithorax,* have not yet been investigated as potential vectors of filariasis in this area. Further surveys have been made to determine which species of Culicoides bite man in the rain-forests and grasslands, and to what extent their prevalence could be explained by the near presence of breeding sites. *C. austeni* was bred in large numbers in the laboratory, and much information was gained concerning the bionomics of this and other species. It was discovered that a filaria resembling *A. perstans* found in the chimpanzee developed to the infective stage in laboratory-bred *C. austeni.*

21. *Epidemiology of L. loa and A. perstans.* The surveys of infections with *L. loa* and *A. perstans* in the human populations in the rain-forests, the forest fringe and the mountain grasslands of the British Cameroons have shown that both parasites reach an equilibrium of high incidence and intensity in small villages in the rain-forest, and that in the neighbourhood of the abrupt forest fringe and in the areas of derived savannah with relict forest, the incidence and intensity falls very rapidly indeed, and that neither infection is transmitted in the grassland. The behaviour of these infections in the different vegetative zones has been correlated with the surveys on the vectors in these zones, and as the results show that both infections are sensitive to interference with their environment, valuable information has been derived concerning the possibility of using effective control measures against infections with *L. loa.*

22. *Chemoprophylaxis and chemotherapy.* Investigation into the chemoprophylaxis and chemotherapy of filarial infections has continued in the Liverpool School of Tropical Medicine. The experimental work on a drug prepared by Dr. E. A. H. Friedheim, namely MSb, has advanced considerably, and it has been shown that one injection of a quantity of this drug of one-fiftieth of the toxic dose will protect a cotton-rat against a filarial infection for between four and six months. Further investigations will, however, be necessary before this drug can be tested on a large scale to ascertain whether it protects man against any form of human filariasis.

Publications

GORDON, R. M., and GRIFFITHS, R. B.—(1952) "An apparatus which enables the process of feeding by mosquitoes to be observed in the tissues of a live rodent; together with an account of the ejection of saliva and its significance in malaria." *Ann. trop. Med. Parasit.*, **46**, 311.

Idem and CREWE, W.—(1953) "The deposition of the infective stage of *L. loa* by *Chrysops silacea* and the early stages of its migration to the deeper tissues of the mammalian host." *Ibid.*, **47**, 74.

HOPKINS, C. A., and NICHOLAS, W. L.—(1952) "*Culicoides austeni*, the vector of *Acanthocheilonema perstans*." *Ibid.*, **46**, 276.

NICHOLAS, W. L., KERSHAW, W. E., KEAY, R. W. J., and ZAHRA, A.—(1953) "Studies on the epidemiology of filariasis in West Africa, with special reference to the British Cameroons and the Niger Delta. III. The distribution of *Culicoides* spp. biting man in the rain-forest, the forest fringe and the mountain grasslands of the British Cameroons." *Ibid.*, **47**, 95.

KERSHAW, W. E., and WILLIAMSON, J.—(1952) "Studies on the chemoprophylaxis of experimental filariasis with MSb (Friedheim). 1. The prophylactic activity during an interval of six months." *Ibid.*, **46**, 268.—(1952) "Studies on the chemoprophylaxis of experimental filariasis with MSb (Friedheim). 2. The retention and distribution of the drug." *Ibid.*, **46**, 320.

Idem, ZAHRA, A., PEARSON, A. F., BUDDEN, F. H., and CAUCHI, F. J.—(1953) "Some observations on the distribution of filaria and Onchocerciasis in Nigeria and the British Cameroons." *Trans. R. Soc. trop. Med. Hyg.*, **47**, 53.

(b) *Filariasis*

East Africa

23. The work of the entomologist to the East African Filariasis Research Unit, Mr. Alec Smith, consisted largely of field studies on the mosquitoes on Ukara Island. The following is a brief summary of the results.

Dissection results. Most of the adult mosquitoes were collected from two villages, one on the coast and one in the centre of the island, in which approximately 25 per cent. of the inhabitants have bancroftial filariasis. Of the eleven species dissected, the numbers found with filarial worms were as follows:

Species	*Dissected*	*Infected*	*Infective forms*
(a) *A. gambiae* Giles ...	3,038	49	12
(b) *A. funestus* Theobald ...	1,102	35	11
(c) *Culex antennatus* ...	34	1	0
(d) *Taeniorhynchus uniformis*	555	3	0
(e) *Taeniorhynchus africanus*	548	3	0

24. *Biting indices.* The results of catches, made seasonally, showed that *A. gambiae* and *A. funestus* are the most numerous species biting man indoors at night, in contrast to the very small numbers of *T. africanus, T. uniformis* and *C. annulioris.* Results from the coastal village showed that *A. gambiae* bites were of the order of 200 per night at the end of the long rains, but only 3 per night at the end of the dry season; the comparable figures for *A. funestus* were 30 and 1 respectively. The biting indices for *T. africanus, T. uniformis* and *C. antennatus,* largely outdoor biters, were high in the coastal village, where breeding in an adjacent bay was abundant, but low in the central village. In the case of *Taeniorhyncus* species the peaks of biting were less extreme; observations indicated that exposure to the bites of this species and of *C. antennatus* was increased by the habits of the Wakara tribe in sitting outside their huts, grouped often around a small fire, before having their evening meal indoors about 9 p.m., and in utilizing latrines sited amongst rocks and closely pruned trees.

25. *Distribution of mosquitoes resting in huts.* The mosquitoes were rarely found higher than 7 feet above the ground. *A. gambiae* and *A. funestus* were much more frequently taken in the darker half of a hut which comprises man's section than in the lighter cattle half. Female *A. funestus* appear to show a much stronger preference for resting in the man's part of the hut than do the female *A. gambiae.* The indoor fire used by the tribe for cooking appeared from the detailed observations made to have no significant effect on the biting activities of these two species. An experiment designed to discover the relative attractiveness of child and adult to the mosquitoes showed no preference to exist. Studies of the host preferences of *T. africanus, T. uniformis* and *C. antennatus* are in train.

26. Dr. Jordan has made observations in the hospital ward and in the field. In a series of 1,356 patients in Mwanza Government Hospital suspected on clinical grounds to be suffering from filariasis, examination of night blood-films indicated that in both sexes the microfilarial rate in non-febrile cases was three-fold that in febrile cases.

During September and October a survey of the incidence and distribution of filariasis was made by Dr. Jordan in the Southern Highlands of Tanganyika. In spite of considerable reluctance on the part of the African to give blood, especially at night-time when lion and other wild beasts make travel on foot hazardous to him, it is considered that the results obtained in 14 villages gave a fairly accurate picture of incidence. All bloods were taken between 8–11 p.m. In certain areas a search for the clinical manifestations of onchocerciasis was also made. Areas of bancroftiasis previously described by other workers were more precisely delimited, and a new area identified. The incidence of *A. perstans* was sought in the same areas, and proved to be rare. Although the pupae of various species of *Simuliidae* were found in some of the areas, none of some hundreds of persons examined showed any nodules of onchocerciasis; but it is thought that, because of the presence of two known vectors, circumscribed foci of the infection will eventually be found there.

Malaya

27. Additional investigations of filariasis, not hitherto financed from Colonial Development and Welfare funds, are herewith reported from the Institute for Medical Research, Malaya.

Mosquito dissections over the past six years from an endemic area of filariasis in Province Wellesley now show that in that particular locality species of *Anopheles* are more important vectors of *Wuchereria malayi*

than are species of *Mansonia.* Elsewhere in Malaya, anophelines had not hitherto been proved to play an important part in the transmission of *W. malayi.*

Filariasis due to *W. bancrofti* is not endemic in Malaya, but a pertinent potential problem has arisen. For the arrival of Fijian troops in Malaya has brought the risk of introducing the Pacific (non-periodic) variety of *W. bancrofti.* The risk has been lessened by the screening by the Military Authorities of the contingents destined for Malaya, and by the treatment with Hetrazan of microfilaria carriers before their arrival, with periodical examinations of the whole battalion in which the Institute is co-operating. Attempts to infect local *Aëdes aegypti* and *albopictus* by feeding them on an untreated microfilaria carrier proved unsuccessful, and it would seem that these species at least are not efficient vectors of the Pacific *W. bancrofti.*

Filariasis, though not a fatal disease, may lead to crippling complications, the unfortunate victim becoming not only a burden to himself and his family, but also an economic loss to the community, for it is on the padi planter that the brunt of the infection tends to fall. Some of the most heavily infected areas in Malaya are under rice cultivation, while others are being investigated as possible padi fields of the future. In these circumstances it is gratifying that, as noted earlier in this Report, the joint recommendation of this Committee and the Colonial Insecticides Committee for the provision of research funds for further elucidation of the problems presenting in Malaya has been accepted by the Colonial Office, and the necessary provision made. Local arrangements for work to begin forthwith in Pahang and Penang have been completed.

Gambia

28. Investigations on filariasis (and schistosomiasis) proceeding at the Field Research Station, Fajara, Gambia, concomitantly with more specialised nutritional studies, and having the ultimate objective of assessing the inter-relation between helminthic infestations and nutrition, are reported at paras. 151–155.

(c) *Guinea-worm*

29. Mr. S. D. Onabamiro continued his investigation on guinea-worm at University College, Ibadan, Nigeria.

Following on the identification of thirty species of *Cyclops* in ponds and streams of South-west Nigeria including four of them which serve as the natural transmitters of the guinea-worm—*Thermocyclops nigerianus* Kiefer, *Thermocyclops inopinus* Kiefer, *Mesocyclops leuckarti aequatorialis* Kiefer and *Microcyclops varicans subaequalis* Kiefer, as reported in the account of last year's work—the year was devoted to a detailed study of the habits of these four species of *Cyclops* and their reaction to infection by the larvae of the guinea-worm.

30. *Diurnal Migration of Thermocyclops nigerianus.* To find out the degree and direction of diurnal migration in this species, and also the amount of fluctuation in its numbers, a village pond was selected and examined over several months. It was observed that throughout the day the greatest number of *Th. nigerianus* were found near the bottom of the pond, but in the afternoon and evening the species migrated both from the bottom and from the surface to the intermediate level. It was also found out that the greatest numbers of *Th. nigerianus* in the pond occurred at intervals of about nine weeks.

31. *Rate of Development of the larvae of Dracunculus medinensis in Cyclops.* Past work has already shown that all the four species of *Cyclops* mentioned above were well adapted for the carriage of the guinea-worm larvae for as long as three to four weeks, but they vary in the number of larvae they can accommodate for that length of time. *Microcyclops varicans subaequalis,* the smallest of the four species, with only one larva will live for up to 21 days; *Thermocyclops nigerianus* and *Thermocyclops inopinus* with two larvae will live as long, and *Mesocyclops leuckarti aequatorialis,* the largest of the four species, can accommodate up to six larvae for about 30 days, given a high degree of aeration in the water.

32. *Dracunculus medinensis* larvae were dissected out of these four species of *Cyclops* at intervals of 24 hours after ingestion to find out the time and number of moulting inside the intermediate host. This investigation which was carried out through the varying seasons of the year reveals the following facts:—

(*a*) The larvae of *Dracunculus medinensis* moult only twice inside *Cyclops,* a fact well known to previous investigators.

(*b*) The moults occur in a shorter time in the dry season in Nigeria, December to May, than in the rainy season, June to November.

(*c*) The longest time it takes the larvae to complete their second moult inside *Cyclops* is 14 days, by which time they become infective to human beings.

Publications

ONABAMIRO, S. D.—(1952) "On the diurnal migration and seasonal fluctuation in the numbers of *Thermocyclops nigerianus* Kiefer in a Nigerian pond." *Ann. trop. Med. Parasit.,* **46**, 38.—(1952) "The geographical distribution and clinical aspects of *Dracunculus medinensis* in South-West Nigeria." *West Africa med.* J., **1**, 1.

Malaria

North Borneo, Sarawak and Brunei

33. The malaria research in North Borneo, Sarawak and Brunei on which Dr. J. McArthur has been engaged for the last 14 years, and with which the Committee have been associated since 1946, was closed down during 1952. Since the work was first established in 1938, its aim has been to develop a means for the eradication of malaria, based on a study of local conditions. The steps toward this have been first to define the distribution and intensity of malaria throughout the land, and the identity and distribution of its mosquitoes; next to discover which mosquitoes are vectors of the disease and which are harmless; then to study the habits of the vectors, and thereby to discover some means, if possible by imitating Nature's own methods in the locality, of eradicating the transmission of the disease.

34. It was first shown that malaria is hyperendemic throughout a great part of Borneo, although some parts are completely healthy. *Anopheles maculatus,* the previously accepted vector, was shown to be almost certainly harmless; and the chief vector throughout the land was found to be *Anopheles leucosphyrus,* which was previously regarded as harmless. Studies on *A. leucosphyrus* showed this insect to be extremely dangerous, but also extremely elusive in both the larval and adult stages. Previously it had been frequently missed even where it was abundant, partly because it often bred in inaccessible places, and partly because it was not a house-haunting mosquito, and fed in the early hours when its victims were asleep. *A. leucosphyrus* was found to breed in seepages only under jungle shade. Consequently,

the jungle-covered hill ravines were the malarious places, and towns, cultivated areas and flat plains were in general healthy at a distance from shaded ravines. It was thus shown that much widespread oiling, drainage and other conventional anti-mosquito measures were not preventing Borneo malaria ; that the considerable sums of money being spent on measures directed against *A. maculatus* were being wasted ; and that the preservation of jungle being carried out for the prevention of *A. maculatus* breeding, although a successful anti-malaria measure in Malaya, was in fact encouraging the breeding of *A. leucosphyrus* and the transmission of Borneo malaria. It was found that the clearance of scrub for a small radius, just sufficient to admit sunlight, over limited situations along the courses of streams, resulted in the immediate eradication of *A. leucosphyrus* breeding.

35. This work came to an end with the war, and its records were largely destroyed. Later however it was re-established, and the Tambunan Experiment was begun in 1949. The experiment was designed to determine whether the admission of sunlight to jungle-covered seepages resulted not only in the eradication of *A. leucosphyrus*, but of the malaria which it carries, and whether this might be the ideal method for Borneo malaria eradication. In this experiment, sunlight was admitted to seepages through out a 10-square mile area of extremely difficult jungle-covered country, embracing five highly malarious villages. This quite limited clearing resulted in an immediate 95 per cent. reduction of *A. leucosphyrus* breeding, a reduction which was maintained without significant further attention throughout the whole three years of the experiment. In this treated area the spleen-rate had remained, as far as can be known, at a constant high level for 14 years. It was over 80 per cent. during every survey before the war between 1937 and 1942, and again since the war. Before the clearing in 1949 the spleen rate was 86 per cent., and it was reasonable to believe that any reduction of malaria following clearing and a reduction of *A. leucosphyrus* breeding would in fact be due to such clearing. A year after the clearing, the spleen-rate had fallen, for the first time on record, to 56 per cent., and in the two subsequent years it fell further to 53 and 45 per cent. respectively.

36. The method appeared to be an effective one for eradication of malaria transmitted by *A. leucosphyrus*. There was, however, a small degree of malaria transmission remaining, as shown by parasites in the blood of young children, and it seems likely that this was due to the infiltration of infected *A. leucosphyrus* through the jungle from the surrounding highly malarious villages which were not treated.

37. A fact which required explanation, but which was most satisfactorily explained, was found in the comparison area three miles away, in which no measures were taken by the Department. Here, spleen-rates which had been 100 per cent. at every examination over 14 years and which were maintained at 100 per cent. during the first two years of the experiment, suddenly fell for the first time on record, to 75 per cent. at the last survey in 1952. This at first seemed to invalidate the figures for the experimental area ; but an examination of the village showed that, whereas conditions in the comparison area had remained exactly the same for many years previously under an elderly Headman, in 1951 this old man died and was replaced by a new Headman, young, enthusiastic, educated at a mission school, and an ex-policeman. This new man had in fact attempted the drainage of seepages and jungle clearance, had distributed paludrine to the children, and taken other measures to clean up his village. Thus, far from invalidating the observations in the cleared area, this village had proved the ability of the people themselves to tackle their own malaria problem

entirely by their own initiative. With this experiment, therefore, Borneo Malaria Research has provided a method of malaria eradication which at the same time encourages the economic development of the land and the prosperity of the people. This method of eradication consists simply in the clearing of scrub and the admission of sunlight.

38. In addition to this, much work has been carried out on the collection and co-ordination of information regarding Borneo malaria, and on the systematics and bionomics of the known vectors. Much of this has already been published. During the final year of work surveys have been completed over the whole of Brunei and the 5th Division of Sarawak, and experiments were begun on the effects of residual insecticides on local vectors. Although this work has been closed down it has provided a basis for future malaria work in Borneo, and the observations made have suggested a method of malaria control which may be applicable elsewhere in the East in jungle areas in which *A. leucosphyrus* may be the vector. The method is economical and its results are permanent. It can be carried out by the people themselves, and its results can be consolidated by agricultural development of cleared areas to the general good of the country.

East Africa

39. Nearly all the research undertaken by the East African Malaria Unit during 1952 has been carried out by the Entomologist. During 1953 this work will perforce mainly lapse, owing to the absence on leave, first of the Director and then of the Entomologist. Towards the end of the year it is hoped that a start will at length be made on the major investigation on the effect of anopheline control in an area of hyperendemic malaria by the use of residual insecticides, which has been planned in association with the Colonial Insecticides Committee.

40. *Resting Places of Adult Anopheles.* Investigations undertaken by the Entomologist during the years 1951–52 have been mainly concerned with the bionomics of adult anophelines. This work has been carried out in the low lying country round Muheza, where a high degree of infestation by one or both of the two vector species is maintained throughout most of the year. Two principal aspects of mosquito behaviour have been studied. The first has been the daytime distribution of the resting sites of *A. gambiae* and *A. funestus* in houses and outside. The house resting population has been studied by spray catching in a large number of normal African houses, and by grouping the catches according to the degree of ovarian development. This has shown that many females of *gambiae* in the later stages of ovarian development are absent from houses, whereas house catches appeared to account for a much greater proportion of gravid *funestus*.

41. This finding suggested the partial use of outside resting sites, and much time has been devoted to searches for these. Small numbers of females of both species have been found in niches in earth banks and tree bases, but much larger numbers have been caught by the use of artificial box shelters partly buried in the ground in suitable shaded sites. Catches made in these shelters, when set up at some distance from houses, have been shown to be closely similar to those made in natural harbourages, and they are considered to produce a valid sample of the outside population. They show that this is mainly composed of unfed and gravid females, the latter group being more numerous in the case of *gambiae* than of *funestus*, and that recently fed females are rarely caught.

42. Further studies have been made in experimental huts fitted with window-traps, so as to observe the exodus of females at various stages of the gonotrophic cycle. It has been found that only about 5 per cent. of *gambiae* leave after feeding, and even fewer *funestus*. On the other hand window-traps left on after dusk caught about 40 per cent. of all the *gambiae* that had fed the previous night, although they were not ready to lay eggs for another 24 hours. By contrast only a negligible number of *funestus* left at this stage.

The difference between the two species confirms the observations on spray catches in houses and in outside shelters, and makes possible the construction of a composite picture of the daytime resting sites of the females in and out of houses. Thus something like 5 per cent. of the biting *gambiae* population and 40 per cent. of the gravid females, i.e. those on the second day of the gonotrophic cycle, rest outside, while the remainder of the fed and gravid population will be found in houses. Rather fewer *funestus* leave houses after biting, and not more than 10 per cent. rest outside when gravid.

43. *Duration of Gonotrophic Cycle.* Observations have also been carried out on the duration of the gonotrophic cycle at Muheza. It is found that for most of the year, when the mean temperature exceeds 74°F., *gambiae* lays its eggs within two days of a blood-meal. Below 76·5°F., *funestus* is on a 3-day cycle, but above 78°F. oviposition in both species follows the blood meal within 48 hours. During the 6 months of the year when *funestus* has a 3-day cycle, a noticeably larger proportion of females leave the houses and rest outside during the second and third day after feeding.

44. *Blood Meals and Ovarian Development.* The second main subject of investigation has been the relationship of the blood-meal to ovarian development. As in most tropical anophelines, a single blood-meal is normally sufficient to ensure the production of a single batch of eggs. In a varying proportion of wild-caught females, however, two blood-meals appear to be required for full development of the ovaries. Detailed studies, which are continuing, both in wild specimens and in newly emerged females from a laboratory colony of *gambiae* (by examination of the ovaries, the ampullae of the oviducts, and the spermathecae) have shown that this group is mainly composed of newly emerged females that have never laid eggs. It appears then that two blood-meals are required to produce the first batch of eggs, and that newly emerged females can be distinguished from all except a very small section of the older population by this character.

45. This work has shown that in any wild population the females may be divided into the following age groups. (1) "Pre-gravid" females that have taken a single blood-meal only, and whose ovaries do not develop beyond an early stage. (2) Primigravid females that have taken two blood-meals, and which are producing their first egg batch. (3) Multigravid females that have taken at least three blood-meals, and have already laid at least one batch of eggs. Analysis of the fluctuations in the proportions of these groups under natural conditions, and their relationship to the sporozoite rate, is being undertaken in order to understand more fully the ageing of mosquito populations.

46. *Residual Insecticides.* Two assays in control of *A. gambiae* are being carried out in collaboration with the Tanganyika Malaria Unit. The first of these has shown that BHC, applied at dosages of 2 gm. per sq. metre at 6-monthly intervals, or 1 gm. at 3-monthly intervals, in the labour camps of an estates, fails to control malaria transmission as measured by human parasite-rates. A dosage of 2 gm. per sq. metre at 3-monthly intervals has

been accompanied by a 50 per cent. reduction in the parasite-rate, a reduction which is difficult to interpret on account of changing circumstances on the estate. The second trial is in an isolated highland area, where it is hoped to abolish the seasonal epidemics that occur from time to time, again by use of BHC as a residual treatment. No results can be expected until the middle of 1953, and their value will depend on the distribution of rainfall.

47. *Chemotherapeutic Trials.* The trial of drugs, including Nivaquine, Camoquin and Daraprim, on indigenous clinical malaria around Muheza is, after the experience of many practical difficulties, now coming into effective operation.

48. *Studies on Anopheline larvae.* Dr. E. G. Christie of the Tanganyika Malaria Unit, who worked at Muheza during the year, reports on his investigations as follows: An ecological study was made of two shallow earth pools near Muheza, Tanganyika. These pools were studied with special reference to the anopheline larvae, and were typical of the residuum of breeding to be found in the dry season in this area. The study was made in a search for explanations of the seasonal fluctuations in numbers of adult *Anopheles gambiae* and *funestus*. It was thought that a progressive study of the changes in conditions brought about by the seasons might yield information where the method of studying numerous sites simultaneously for one factor had failed.

49. The results showed a peak of numbers of *funestus* larvae, fine plankton numbers, and volume, related in a suggestive manner to the pH and the Tidy figure, occurring about one month after the end of the "long rains". The numbers of larvae caught off the peak were too small to permit the use of Bates's method of comparing the proportion of the instars, and there is nothing in these results to suggest that events in the larval environment were responsible for an increase in adult numbers. The experiment must be repeated with a concurrent estimate of the capacity of the environment to support larval growth, using floating cages. The events observed may be entirely unconnected with the march of events in the adult anopheline population, other than having a common origin in climatic events; but the suggestion of extensive cyclical changes in the pools is important, and must have some bearing on anopheline survival.

50. It has been found possible to recover all the anopheline larvae from breeding sites of restricted size (e.g. not more than 150 gallons) by baling the water out through a wire gauze sieve of 60 or 80 mesh into a large drum. The sieve is then stood in clear water, when the larvae can be picked off the surface with a pipette, counted and returned to the site. The water is similarly returned to the site, unchanged except for the mixing that it has undergone. This method permits the accurate numerical study of the whole population of larvae, and their return intact to their environment. Pits were dug near Muheza which were populated naturally by *Anopheles gambiae*. Applying this method of study, it was found that, during and immediately after the rainy season in April-May, the chances of survival from hatching to pupation were of the order of 11 per cent., whereas in subsequent months this figure dropped to near zero, and concurrently there was a big increase in the numbers of *Culex tigripes* larvae, and of other suspected predators. At present, in the hot dry season, one of the pits is being regularly freed of predators, and events to date point to a very high survival rate. This method has evident possibilities in estimating the effects of experimental variation of larval environment, or of larvicidal treatments.

Trinidad

51. Mr. Senior-White continued his entomological observations in relation to various malaria control projects in Trinidad which are in hand and also his studies on the bionomics of the local mosquitoes, particularly *A. aquasalis*. In the area north of the Laventille mangroves, where control had been undertaken by the filling, draining and oiling of all breeding places in the open grass stretch, the measures applied have appeared to have little effect on *A. aquasalis* densities, as judged by trap captures and outside resting searches in the adjacent suburbs of Laventille-Success. Males were only reduced by 0·9 per man hour and female density rose from 2·4 to 3·8. This production must have emanated from the actual mangrove into which breeding may have been driven by the sanitation of the Paspulum zone, or by indiscriminate felling of mangrove which provided increased breeding facilities. Anopheline production in rice fields and in the Tilapia fishponds, which were created by the Agricultural Department in 1952, is also being investigated. Although located nearly at the inland limit of heavy *A. aquasalis* production the area was found to be more productive of that species than of *A. albitarsis*. After an initial outburst of *A. aquasalis* before the Tilapia density was established the prevalence of *A. aquasalis* in the fishponds fell almost to nil.

52. Studies on the effect of residual insecticide spraying were carried out in three mud huts fitted with Muirhead-Thomson pattern exit traps, the bait being human. One hut was sprayed with water-suspension DDT at 100–125 mg. para-para, one with Gammexane at 10–12 mg. Y-isomer in water per square foot and the third left unsprayed for comparison. DDT was found to be effective up to five months and Gammexane only to less than two months. While fresh, Gammexane showed a repellency effect to entrance, not produced by DDT. This effect appeared to operate from outside the hut, presumably by odour from the eave-space. Immediate death (dead on floor) was higher with DDT than with Gammexane but the percentage of entrants living to reach the traps was much the same with both insecticides. Human bait was not found to be very effective for *A. aquasalis* even without animal diversion in the vicinity. In a test with one hut baited with a calf and the other with two men the total entrance in the calf hut was 696 as compared with 12 and 14 only in the other.

53. A year's study was made of the comparative breeding in permanent and temporary pools in relation to the finding reported by Muirhead-Thomson that production is 50 per cent. higher in temporary pools. The results did not confirm his finding. Further studies on the problem will be undertaken in relation to the chemical characters of the waters, with the assistance of a chemist. Egg survival in damp earth was investigated and it was found that hatching cannot be delayed longer than 48 hours. Larvae then half emerge but do not pass into the second instar until reflooded. A certain amount of survival was found up to 15 days (one high tide period). Studies on micro-climates of *A. aquasalis* rests were commenced, 2,000 parallel observations of humidity and light-incidence being made. It was, however, found that the Penman's apparatus for humidity measurement was not sufficiently accurate for use under certain conditions and could not be used for investigations on *A. albitarsis* and *A. neomaculipalpus*.

The study of blood meals of mosquitoes by means of precipitin tests was held up to a considerable degree owing to pressure of other work in the testing laboratory but in two localities in St. Lucia, when it was possible to do some work, the tests made gave an animal index of 80 per cent. and 85 per cent. for outdoor resters (*A. aquasalis*), a value hardly surpassed by any other anopheline.

Publications

SENIOR-WHITE, R. A.—(1951) "Studies on the Bionomics of *Anopheles aquasalis* Curry, 1932 Parts I and II," *Indian J. Malariology*, **5**, 293 and 465—(1952), Part III, *Ibid*, **6**, 29.

MUIRHEAD-THOMSON, R. C. AND MERCIER, E. C.—(1952) "Factors in malaria transmission by *Anopheles albimanus* in Jamaica. Part I." *Ann. trop. Med. Parasit.*, **46**, 103.*

Gold Coast

54. Dr. R. C. Muirhead-Thomson, from his headquarters in Accra, undertook investigations on the human reservoir of malaria infection in villages in a hyperendemic area of West Africa. The work was based on the study of the distribution of bites and feeds of anophelines in persons of different age-groups and on gametocyte carriers and their actual infectivity to mosquitoes of the local species. This work was an extension of previous observations in the Caribbean, where it had been found that the bulk of mosquito feeds were in the older children and adults and, also, that bloods which had extremely low crescent levels were often infective. The high incidence of malaria in the area under study is shown by the parasite rates for the village of Weija which were 86·5 per cent. for the 0–1 year age group, 100 per cent. for the 2–4 year group with figures descending to 40·3 per cent. for the 15 year and over group. In spite of this the people were well nourished and almost unaware of malaria as such, and showed no obvious ill effects from their heavy parasite load. A search for gametocyte carriers was made by the examination of two, three or four hundred thick film fields, if necessary, and the actual infectiousness of the carriers was tested by means of experimental feeds of laboratory-bred *A. gambiae*. The crescent-rate for one village was found to vary from 40·4 per cent. in 0–1 year age group to 5·9 per cent. in the 15 year and over group. These figures obtained by extensive search of thick films were much higher than had previously been reported from West Africa by the use of thin films.

55. The infectivity to mosquitoes of 42 of the crescent carriers was tested by feeding large batches of *A. gambiae* on them with subsequent examination for oocysts of *P. falciparum* which constituted 94·6 per cent. of the infections. At the first experimental feed the percentages positive were 15 per cent., in the 0–1 year age group, 37 per cent. in the 2–4 age group and 37 per cent. in the 5–9 age group. Real infectivity as estimated from gametocyte-rate and the results of feeding tests was calculated to be 6 per cent., 9 per cent. and 9 per cent. respectively in these age groups. As had been found in Jamaica, and had also been previously reported from West Africa, infective feeds were obtained with very low crescent densities. Many positives were obtained with a level of 3 per 1,000 leucocytes and in individual instances with levels down to as low as 0·1 crescent per 1,000 leucocytes. Bloods which had been rejected as negative on microscopical examination of thick films sometimes proved infective to mosquitoes and in some cases it was necessary to feed a large number of mosquitoes to obtain a positive result. In contrast, subjects in whom blood crescents could be found without difficulty frequently proved to be uninfective to mosquitoes. It is concluded that blood examination alone cannot give a reliable indication of the status of an individual as a source of infection.

---

* Relates to research done in Jamaica in 1950, vide this Annual Report for 1950–51, paras. 45–50.

56. In the course of the malaria investigations a high filaria infection rate was found in *A. gambiae* and *A. funestus* caught in village houses. This appeared to be a *W. bancrofti* infection. Night feeding tests were carried out with *A. gambiae,* and on dissection of the survivors 12 days later the proportion infected was ascertained. This varied in different subjects on which mosquitoes had been fed, from 50 per cent. to 2 per cent. The infection level was low, and seldom were more than one or two mature larvae found in the mosquitoes. *Anopheles* were not found to be infected unless microfilariae were present in the peripheral blood at the time of feeding, and usually in numbers. Night feeding on the same subject at two-hour intervals showed the level of infection to be related to the period of microfilaria abundance between 9 and 10 at night and 4 and 5 in the morning.

57. The sporozoite- and oocyst-rates in *A. gambiae* and *A. funestus* caught in village houses were investigated ; and it was found that the sporozoite-rate in *A. gambiae* was 30 times greater than in *A. funestus* under the same conditions, while the oocyst-rate was only four times as great. Whether this finding is due to a shorter life span of *A. funestus* is uncertain. The proportion of the anopheline population taking an infective feed at any one time was ascertained by the dissection of wild-caught engorged anopheles four to seven days after capture. The number showing *falciparum* oocysts of that age was considered to give a reliable indication of the degree of exposure of the mosquitoes to human malaria infection at different times of the year. The figures for the months of September and October for *A. gambiae* and *A. funestus* were respectively 16 per cent. and 6 per cent. These figures, considered in relation to the gametocyte rate found in adolescents and adults, support the contention that these groups must have a higher proportion of infectors than is suggested by the blood survey.

58. In contrast with this fairly low malaria infection-rate, about 50 per cent. of both *A. gambiae* and *A. funestus* were found to show immature thoracic forms of filaria larvae, but the proportion surviving long enough to develop mature forms was only 4·1 per cent. for *A. gambiae* and 1·7 per cent. for *A. funestus,* suggesting a higher mortality in *A. funestus.* Experimental studies made showed that both malaria and filarial infection can proceed side by side and there is no physical barrier to the same anopheline picking up both infections. Mixed infections are, however, uncommon, and their scarcity is most likely to be related to the fact that filarial infectors in the village community belong to different age groups.

Nigeria

59. Although the Committee has not been directly concerned with the work of the Nigeria Malaria Service during the period, it is considered suitable to include here some account of its work. Points in the Report of the Director, Dr. L. J. Bruce-Chwatt, are summarised:

60. *The Ilaro Experimental Malaria Control Scheme,* in which residual spraying with BHC wettable powder has been carried out at four cycles a year, is now in its fifth and last year. The following results are reported:

(*a*) The average number of cases diagnosed as malaria at the Ilaro dispensary fell from 6·2 per cent. of total attendance in 1949 to 0·8 per cent. in 1951.

(*b*) The Crude Birth-Rate rose from 34·8 per 1,000 in 1949 to 36·2 in 1952 after passing through a peak of 42·5 in 1951.

(*c*) The Crude Death-Rate fell from 15·6 in 1949 to 12·3 in 1952.

(*d*) The Infantile Mortality-Rate fell from 137 per 1,000 in 1949 to 66·7 in 1952.

(*e*) The spleen-rate in age group 1–2 years fell to about half the previous rate of 60·3 per cent.

(*f*) The parasite-rate in the same group decreased from 84·1 to 29·6 per cent. Spleen- and parasite-rates for adults did not change.

The studies made on the mosquito vectors in the same area showed the following changes—

(*a*) The average anopheline density of *A. gambiae* decreased from 1·9 in the control period to 0·17, 0·32 and 0·57 during 1950, 1951 and 1952 respectively. The corresponding figures for *A. funestus* were 2·0, 0·05, 0·004 and nil.

(*b*) The infectivity of *A. gambiae* decreased from 5·0 in 1949 to 0·6 per cent. in 1952. The respective figures for *A. funestus* were 4·1 per cent. and nil.

(*c*) The anopheles larval indices for *A. gambiae* decreased from the peak seasonal figure of 180–380 larvae for 100 dips in 1949 to a peak figure of 20 in 1952. The respective figures for *A. funestus* were 51–62 in 1949 and nil during most of 1952.

As the area under control was a relatively small one it appears possible that human infections in Ilaro during the experimental period may have been due to influx of mosquitoes from outside. The average cost of the Ilaro scheme over the period 1950–52 amounted to 4s. 9d. per capita per annum.

A corresponding control scheme on a much larger scale is planned for Western Sokoto. This will cover an area of some 500 square miles with a population of 100,000. The project will be undertaken in association with the U.N. International Children's Emergency Fund and the W.H.O.

61. *Investigations on malaria in pregnancy.* Studies on placental blood showed 15·8 per cent. to be infected with malaria parasites of which *P. falciparum* was the commonest species. The percentage of still births was found to be higher with infected placentas and the mean weight of full-term infants was higher when the placentas were uninfected. Experimental studies were carried out on rats infected with *P. berghei* to determine whether immunity may be transmitted by the mother to her offspring. No immunity was shown by the offspring of mother rats who had been immunized by intraperitoneal infection of repeated doses of the parasite when they were challenged at periods up to 15 days from birth. Where the challenging infection was given at the age of three weeks the fatality rate was reduced to 40–50 per cent. Over 75 per cent. recovered when challenged towards the end of the 4th week of life. Control litters from normal mothers invariably died when infected at any age from birth up to two months of age. It is considered that there is some evidence that tolerance to *P. berghei* is transmitted mainly, if not solely, through the colostrum and milk of immune mothers. There was no evidence of transplacental transmission of the infection from the infected mother to her progeny.

62. *Therapeutic trials of some new antimalarials* were carried out on African schoolchildren of 5 to 10 years of age naturally infected with *P. falciparum*. These were based on the observation of the speed of decrease in parasitaemia. The drugs tested were Nivaquine (chloroquin sulphate) Daraprim (pyrimethamine) Camoquin (amodiaquin) and a new acridine derivative, Azacrin. All four drugs were found to be good schizonticides and had no toxic action at th dosage employed. None showed direct gametocidal action.

63. *Herbicides.* Laboratory and field trials of herbicides were carried out to determine their value in controlling *Pistia stratiotes* (water lettuce) the growth of which interferes with the use of larvicides. The preparations Agroxone and Feroxone were found to be effective in laboratory trials in dilutions as high as 1 in 20,000 but on Pistia growing in burrow pits they were only effective in concentrations of 1 in 100. Thus they did not provide an economical solution of the problem.

64. *Larva control.* A cheap, easy and simple method was evolved for the control of breeding of both anopheline and culicine mosquitoes in the water storage pots and in the region. Larvicidal Pellets were prepared by adding 1 part of BHC wettable powder to 4 parts of cement and 24 parts of fine sand. One pellet added to the usual Nigerian 4-gallon water pot was found to remain effective for at least 2 to 3 months. The treated water is not toxic to man and no permanent objectionable taste is imparted to the water.

A portable fog generator of new type was tested in the field for its value in controlling mosquitoes in rural areas. The BHC/diesel oil fog produced was found to be highly effective on adult mosquitoes, and also on larvae of *A. aegypti* at short range. It was concluded that the apparatus may prove a valuable weapon for controlling yellow fever in rural areas in West Africa.

Publication

BRUCE-CHWATT, L. J.—(1952) "Malaria in African infants and children in Southern Nigeria." *Ann. trop. Med. Parasit.*, **46**, 173.—(1952) "A diagram of the epidemiology of malaria." *Trans. R. Soc. trop. Med. Hyg.*, **47**, 166.

Idem and ARCHIBALD, H. M.—(1953) "Field trials of new antimalarials in West Africa." *Brit. med. J.*, **1**, 539.

Malaya

65. *Malaria control in rural areas.* Dr. Wilson and Dr. Edeson, the Malaria Research Officers of the Institute for Medical Research, Kuala Lumpur, completed at the end of 1952 the third and final year of the field experiment in malaria control in rural areas, in which, in four valleys, the effect of residual insecticides was compared with that of weekly suppressive proguanil. During the first two years the investigation was financed jointly by Colonial Welfare and Development research funds and by the Government of the Federation of Malaya; during the third year, by the latter alone.

66. *Chemotherapy.* Malaria patients admitted to the General Hospital, Kuala Lumpur, and the District Hospital, Tampin, were treated with various synthetic drugs. Chloroquine (Nivaquine) and amodiaquin (Camoquin) gave good results in the single-dose treatment of acute malaria, and were about equally effective. The new drug pyrimethamine (Daraprim) proved disappointing. It failed to cure 13 out of 97 patients with light infections of *P. falciparum*, and an increase of dosage to a total of 300 mg. given in a five-day course did not improve the results. A suggestion that these failures may be due to the known presence of proguanil-resistant strains, and a possible cross-resistance between proguanil and pyrimethamine, is not supported by the evidence available at present.

67. Throughout this period the comparison (untreated) area has had a consistently higher rate of proved malaria in dispensary patients, and, for two of the three years, a considerably higher infant infection rate. Parasite- and spleen-rates of children examined at periodic surveys have fallen in all areas, though much more rapidly and to a greater extent in the protected areas. These rates are summarised below:—

Parasite- and spleen-rates of children 12 years and under examined at surveys

Area	Number examined (smallest–largest)	Parasite-rate per cent.							Spleen-rate per cent.						
		1949		1950		1951		1952	1949		1950		1951		1952
		1st	2nd	3rd*	4th	5th	6th	7th	1st	2nd	3rd*	4th	5th	6th	7th
DDT ...	378–529	40	33	16	12	5	4	6	66	64	45	36		17	19
BHC ...	138–183	32	38	17	12	12	3	6	60	59	45	48	30	26	21
Proguanil ...	288–529	37	25	5	3	1	1	2	59	53	34	20	15	15	13
Comparison	273–354	28	24	17	24	18	9	10	54	54	49	51	34	40	32

* Control work started about 4 months before this 3rd survey.

68. The slight rise in parasite-rates in the DDT and BHC sprayed areas shown in 1952 may reflect continued transmission of malaria despite control, but is thought to be due, at least in part, to movement of population into the protected areas from outside. Although weekly suppressive proguanil gave slightly better results than the residual insecticides, the regular distribution of any drug to a scattered rural population is difficult to organise, and one cannot hope to supervise the taking of the required dose. House spraying with DDT—or one of the newer residual insecticides—is therefore considered to offer the best prospects for the control of malaria in the rural areas of Malaya. Where the vector of malaria is a mosquito less susceptible to insecticides than *A. maculatus*, as several of them have proved to be, then more frequent spraying may be necessary to obtain satisfactory results. Whatever the vector may be, however, eradication either of the mosquito or of malaria by house spraying alone is not to be expected. This means that spraying programmes, once started, must be continued indefinitely.

A full report of this experiment in malaria control is being prepared.

69. *Effect of residual insecticides on Malayan mosquitoes.* The Entomologists of the Institute, Mr. Reid and Mr. Wharton, have made further tests of residual insecticides in window-trap huts. Dieldrin at 40 mg. per square foot applied as a wettable powder remained effective (i.e. 24 hour mortality not below 50 per cent.) for 4 months against *A. sundaicus;* this compares with last year's results of 3 months for DDT at 200 mg. and 2 months for BHC at 40 mg. gamma isomer per square foot. This dose of Dieldrin gave kills of 80–100 per cent. against *Culex fatigans* for about 2 months, after which the kill dropped rapidly to well below 50 per cent. This is a much better result than can be obtained with either DDT or BHC against *C. fatigans;* DDT kills very few, while BHC, though highly effective for the first week or so, kills less than 50 per cent. by the 3rd to 6th week after application. Dieldrin was also tested against *A. maculatus.* A dose of 40 mg. was still giving a kill of over 90 per per cent. in the 3rd month, after which the numbers of adult *A. maculatus* became too low to continue the observations. With a dose of 10 mg. the mortality had fallen to 50 per cent. in the 2nd month, and was only about 15 per cent. during the 3rd month. These results were no better than those obtained with BHC in 1951, and further experiments with Dieldrin are planned.

70. Experiments with window-trap huts were started in 1948, and reports have been published from time to time. Results to date suggest the following broad conclusions regarding the effectiveness of residual insecticides against various species of mosquitoes in Malaya:—

(i) *Anopheles maculatus*, the principal vector of malaria, is more readily killed than most other Malayan species except perhaps *A. umbrosus.*

(ii) Doses of DDT and BHC that remain effective for nearly 6 months against *maculatus* last only about half that time against *A. sudaicus;* probably the same is true for *A. barbirostris* and species of *Mansonia* (the vectors of Malayan filariasis).

(iii) *A. letifer* is not readily killed by DDT and the various species of *Culex*, especially *C. fatigans*, are hardly affected.

(iv) DDT even when fresh does not kill more than 80–90 per cent. even of susceptible species, but BHC and Dieldrin at first give a complete kill of all species. Against those species not readily killed by DDT, however, BHC rapidly loses its effect, and to a lesser extent the same is probably true of Dieldrin.

71. Additional malaria investigations, not financed from Colonial Development and Welfare funds, have also been made at the Institute for Medical Research.

A proguanil-resistant strain of *P. falciparum* from the Tampin area has been sent to the Imperial Chemical Industries Research Unit in East Africa. Trials by this Unit to determine whether resistance extends to the pre-erythrocytic stages of this strain of parasite have not yet been made public.

The malaria parasite, *Plasmodium knowlesi,* originally isolated in India from a monkey thought to have been imported from Malaya, and maintained for many years at the Malaria Institute of India, has apparently lost its virulence for rhesus monkeys. A fresh Malayan strain, recently isolated by Dr. Edeson from a monkey, *Macaca irus,* trapped near Tampin, appears to be virulent for the Indian rhesus monkey, *Macaca mulatta.* This strain, the Nuri strain, named after the valley where the monkey was trapped, has been sent to the Malaria Institute of India and to the I.C.I. Biological Research Laboratories in England.

72. The feeding and resting habits of *A. sundaicus* and *A. barbirostris,* and of the many other culicines and anophelines that occur with them, are being studied by comparative trapping with human and animal baits, and by precipitin tests of blood-fed mosquitoes caught in their out-door daytime resting places. This information may throw light on the potential status of different species as vectors not only of malaria but also of other diseases such as Japanese encephalitis, filariasis and yellow fever.

Publications

FIELD, J. W., STRAHAN, J. H., EDESON, J. F. B., and WILSON, T.—(1952) "Studies on the chemotherapy of malaria. 1. The suppression of malaria by synthetic drugs." *Med. J. Malaya,* **7**, 67.

WILSON, T. AND EDESON, J. F. B.—(1953) "Treatment of acute malaria with pyrimethamine." *Brit. Med. J.,* **1**, 253.

MALARIA ADVISORY BOARD, FED. OF MALAYA—(1952) "Malaria control by modern methods." Circular No. 7.

Gambia

73. Malaria investigations proceeding at the Field Research Station, Fajara, Gambia, as part of a study of the inter-relation between malaria and nutrition, are reported at para. 145.

Virus Diseases

(a) *The West African Virus Research Institute, Lagos, Nigeria*

73. The shortage of Medical Research Officers has persisted, but the disadvantage of this situation has been somewhat offset by the increase in numbers of laboratory superintendents, so that the facilities available have for the most part not been lying idle. Of the two Research Medical Officers present at the beginning of the year one was away for five months on leave, but was able to benefit by a short stay with Sir Macfarlane Burnet at the Walter and Eliza Hall Institute in Melbourne, Australia; the other proceeded on leave in August and has since resigned. The Entomologist attended the course organised for W.H.O. by the Malaria Service of Nigeria. He proceeded on leave in August and has since resigned. The junior staff includes one Senior Laboratory Superintendent, four Laboratory Superintendents, one Maintenance Engineer and a Secretary-Typist. A Spinco preparative ultra-centrifuge and an air-conditioning plant

for the main laboratory are now installed and in operation; an emergency electric power plant is expected to be ready for use shortly. A Berkeley Messenger Caravan has been purchased and fitted by the Institute for use as a mobile virus laboratory. Its value has already been amply demonstrated during the investigation of a suspected outbreak of yellow fever in Eastern Nigeria.

74. The research programme of the Virus Research Institute has continued, the main items being the epidemiology of yellow fever, the study of the behaviour of the virus in human cases and the production of immune bodies, the study of the methods of use of different types of yellow fever vaccine and their application to the control of yellow fever, and the discovery of the aetiology of short-term fevers, and their possible vectors.

75. *Yellow fever epidemics.* The examination of material collected from patients during the epidemic of yellow fever in Onitsha province has been continued. A total of 33 strains of viscerotropic virus have been isolated and studied. Surveys of immunity to yellow fever among persons not inoculated against yellow fever have been made in six separate areas in Onitsha and Ogoja provinces, to determine the past incidence of yellow fever, and are being correlated with a survey of the presence of monkeys. Those surveys have also provided a valuable guide for the Health authorities in regard to danger spots for future epidemics. Another small epidemic of yellow fever in Onitsha Province was detected in January, 1953, and investigated on similar lines to the earlier epidemic in the same Province investigated in November and December, 1952.

76. *Yellow fever vaccine.* Reactions following the administration of French neurotropic vaccine produced by the Pasteur Institute, Dakar, have been studied in detail, particularly in regard to the virology. Concrete evidence has been produced for the first time that this vaccine is not as safe as previously described. Post-vaccination surveys have been made for the production of immunity after the administration of this vaccine. In order to assist the Headquarters Laboratory of the Nigerian Medical Service in which 17D yellow fever vaccine is in production, tests have been made on this vaccine to demonstrate its conformity with international standards; and surveys have been made for immunity after vaccination. The results will be included in the relevant report of the Laboratory Service. It was demonstrated previously in these laboratories that yellow fever 17D vaccine can be administered by scarification. Large-scale field trials are being made in co-operation with the Health authorities, Eastern provinces, to ascertain whether in practice administration by scarification is more suitable from economic and epidemiological aspects for mass immunisation.

77. *Other viruses.* Material has been taken in the Greek and General Hospitals, Lagos, from patients with diseases which might be of viral origin. Two strains of poliomyelitis, one of herpes simplex and two others of doubtful aetiology have been isolated. During the investigation of a suspected outbreak of yellow fever in the Eastern provinces a neurotropic virus was isolated from a girl suffering from fever. The virus is not yellow fever and is the first definite isolation of a neurotropic virus from the blood of a patient in West Africa. It is closely related to Zika virus. Unsuccessful attempts have been made to isolate virus from patients suffering from influenza-like diseases. The mouse viruses of Theiler's mouse poliomyelitis and Niggs pneumonitis have been isolated from the mouse colony, and tests devised to eliminate confusion which might be caused by their presence. Their is no evidence of endemic lymphocytic choriomeningitis virus nor the S.K. group of viruses within the Colony.

Towards the end of the year a pilot experiment has been initiated to investigate the transmission of viruses by culicoides. Batches of wild caught culicoides midges are ground up and inoculated into chick embryos and albino mice.

78. *Entomology.* The life cycles of strains of *Aëdes aegypti* from Nigeria, Poona, Karachi and Delhi have been compared, and Dr. Busvine from the London School of Hygiene and Tropical Medicine studied their different susceptibilities to insecticides. A method for studying the biting preferences of *Aëdes aegypti* in regard to adults, children or other groups has been worked out and preliminary experiments conducted.

The routine testing of sera from Nigeria and the Gold Coast for the diagnosis of yellow fever and the routine testing of vaccine prior to distribution have continued.

Publication

MACNAMARA, F. N.—(1953) " The susceptibility of chicks to Semliki Forest virus (Kumba strain) ". *J. trop. Med. Parasit.*, **47**, 9.

(b) *The East African Virus Research Institute, Entebbe, Uganda*

79. During 1952 the main investigations have been maintained, and several new lines initiated. Further expansion is, however, desirable on the clinical side; for although much material is received from East African hospitals attempts to isolate virus rarely succeed. Recent work by an American unit in Egypt has shown that by the time a case reaches the hospital bed the chances of virus isolation are very small. An earlier approach through out-patient dispensaries is needed, to facilitate which the addition of a whole-time clinical worker to the staff is being sought. Collaboration with laboratories and museums in many parts of the world continues; and virus strains, breeding animals and biological material have been supplied on request to various workers.

80. *Poliomyelitis virus.* During the past year nine isolations of virus have been made from poliomyelitis cases in Uganda. The material has been sent to the United States for final study. Since in Uganda the epidemiology of the disease differs in some respects from that of temperate climates, investigation is necessary to determine whether these differences are due to the environment or to the virus. Two of the strains concerned were passed repeatedly in monkeys. Their behaviour appeared to be normal. The Institute was visited this year by Dr. Weller, an American worker whose culture methods have revolutionised the study of poliomyelitis in the field and laboratory. It is collaborating with him by contributing samples of sera from wet and dry areas in Uganda; his studies may clarify the situation in East Africa. Two species of bush-babies (*Galago crassicaudatus* and *G. senegalensis*) have been experimentally infected. Neither showed any obvious illness.

81. *Field and laboratory studies on yellow fever.* The main field work on yellow fever is now concentrated in the drier country where bush-babies (*Galago* spp.) and not monkeys appear to be the main animal hosts of the virus, as was shown last year. In such areas mosquitoes disappear, or almost so, during dry weather; and it is felt that in the case of bush-babies the disease may be transmitted by the blood-sucking mites which infest their fur and also their nests in hollow trees. Many bush-babies have lice as well, and these must also be tested. The mites are a difficult group, and the collections made are still under study by systematists. Meanwhile work has begun on methods of feeding and colonising the mites, with the object of

attempting to transmit yellow fever virus from bush-baby to bush-baby by their agency. An important point is that in the case of some other virus diseases mites have proved to be capable of passing on virus from one generation to the next through the eggs, and thus might represent a true "reservoir" in which virus could lie dormant for long periods. This year 140 specimens of the small galago (*G. senegalensis*) have been collected from Karamoja District; and study of them has shown that animal yellow fever exists in the extreme north of Uganda to within a few miles of the Sudan and Kenya borders. Nine others were collected on the Kenya Coast, in arid bush south of the Tana River; one proved to be immune. A picture of the rather unusual habits of these curious and specialised animals is gradually evolving. Their distribution is patchy, and they are associated with trees of certain kinds. They are wholly nocturnal, and the small species feeds almost entirely on insects, though the large one eats a good deal of fruit as well. In a study of the nocturnal activity of the galagos, a cage with a sprung floor attached to a recording apparatus is used, every movement being recorded on a moving drum. Experimental yellow fever infections in *G. senegalensis* and in a tiny forest species, *G. demidovii,* are being studied. The response to inoculation is variable, some animals circulating much virus and others none. Perhaps detectable immunity does not last so long in these animals, the refractory specimens being those which have already had the disease, though immunity is no longer detectable in them by ordinary methods. This important point is now under investigation.

82. As virulent yellow fever virus cannot be imported into South Africa, at the request of the South African authorities the capacity of two of their mosquito species to transmit the virus by bite has been tested. In the first, *Aëdes* (*Stegomyia*) *strelitziae* Muspratt, transmission from monkey to monkey was easily achieved, but further work will be necessary before a final answer can be given. Survey work this year has been confined to Karamoja, where 103 human sera were collected. The only immune specimen came from a person known to have been vaccinated.

83. An Institute team investigated a fatal case of yellow fever which occurred in a European in Toro District early in 1952. This is the first fatal case reported from Uganda. The deceased was living at Kasunganyanja on the Fort Portal–Katwe road at the time when he acquired the disease. It was found that there was a high incidence of immunity to yellow fever among the monkeys of a forest strip only about a quarter of a mile away, and that *Aëdes africanus,* a known vector of the disease, was very common in the neighbourhood.

84. In 1950 the World Health Organisation initiated a large-scale survey to determine the southern limits of human yellow fever in Africa. Part of the work has been carried out in conjunction with the Entebbe Institute, where 7,500 sera have been tested, 4,900 during 1952. Towards the end of the year 450 sera per week were being tested. The total number of mice used has been about 51,000. The work is now completed, and will soon be reported in full. Immune sera were found in samples from Tanganyika, Northern Rhodesia, Nyasaland, Zanzibar and Pemba, the Southern Belgian Congo, and Angola.

85. *Mengo Encephalomyelitis Virus.* This virus, first isolated at Entebbe, is a member of a widespread group of which the natural hosts appear to be rodents. A survey of 306 wild rodents belonging to seven species was made. The positive results were confined to two domestic or semi-domestic species, the black rat (*Rattus rattus*) and the multimammate rat (*R. coucha*). Almost a quarter of the 82 black rats examined were found to be immune,

which accords with previous results. It was confirmed that the virus may be passed in the faeces by infected rats. Sera from an outbreak of mild human encephalitis were tested against Mengo virus, but no unequivocal evidence was found that it was responsible.

86. *Rift Valley Fever Virus.* This important disease of sheep and cattle caused a most destructive outbreak in South Africa recently, and another in Kenya. Human cases also occurred, some with serious after-effects on vision. As the virus is known to exist in Uganda (having been isolated by Institute staff from wild mosquitoes in 1944) some survey work was carried out to appraise the local situation. Sera from 46 people, 52 cattle and 16 wild animals from Karamoja district were tested. All were found to be negative. A few specimens from the Congo have been tested and found negative, and there were no positives among 50 children from Barotseland, Northern Rhodesia. The virus is an excellent one for technical study in the laboratory; and attempts to find a really suitable mosquito host for it are being made. *Aëdes aegypti* would be the easiest to breed and to use, but it is not yet known finally if it can transmit the virus by bite. Work is in progress to investigate this point; in some specimens virus multiplies to a considerable extent. A very useful new method of feeding mosquitoes on narcotised mice has been worked out and is in use.

87. *Coxsackie Virus.* A strain of this virus was isolated from a member of the Institute staff during 1952. This is thought to be the first isolation of a virus of this common group from Uganda. The commonest manifestations appear to be muscular pains, particularly in the neck and back, and fever of a few days' duration.

88. *Entomology.* Many mosquitoes of the genus *Aëdes* have eggs which can resist dessication for long periods. Even when conditions become suitable for hatching, however, the response is variable. After many factors had been studied it was found that the basis of the phenomenon was genetical. Thus, by selective breeding, it might be possible to produce a strain with a very regular response. Such a strain would be most valuable for laboratory use.

In the case of insect-borne disease it is the older females, biting for a second or subsequent time, which actually transmit the organisms. Field work carried out by Institute staff leads to the belief that old and young mosquitoes may bite at different times. Investigations on this point are being followed up, and it has been shown that mosquitoes bite at a very fixed point in ovarian development, though it has not yet been possible to determine with certainty which of them comprise the old group.

89. *Studies on virus multiplication and virus tissue relationships.* Certain fundamental problems concerned with the basic mechanism of virus multiplication are under study. The work is being carried out in eggs, with influenza virus. The primary object is to determine the manner in which virus is liberated by the infected cell. The subject is important, and the approach highly technical. Substantial progress has been made.

90. *Personnel, Buildings and Animal Colonies.* During the year the Director, Dr. Eric Horgan, retired, and was succeeded by Dr. A. J. Haddow. An overhaul of the main laboratory, animal houses and stores is well advanced, and it is hoped soon to have house and laboratory space for visiting workers. A constant temperature room (essential for detailed insect and virus studies) is being built. One of the major expenses of the Institute is the mouse colony, which varies from 20,000–25,000 mice at any given time. As the cost of feeding is high, and constantly rising, an extensive

experiment was made designed to find a diet at once cheap and satisfactory, which succeeded; the new diet will shortly be introduced. Fewer rhesus monkeys were born this year—only ten—bringing the total born to 130. In the mouse colonies 157,358 were born. Stocks of guinea-pigs, cotton-rats, rabbits and fowls were also maintained.

Publications

BUXTON, A. P.—(1952) "Observations on the diurnal behaviour of the redtail monkey (*Cercopithecus ascanius schmidti* Matschie) in a small forest in Uganda." *J. Anim. Ecol.*, **21**, 25.

DICK, G. W. A.—(1952) "Zika virus (II). Pathogenicity and physical properties." *Trans. R. Soc. trop. Med. Hyg.*, **46**, 521.

Idem and GEE, F. L.—(1952) "Immunity to yellow fever nine years after vaccination with 17D vaccine." *Trans. R. Soc. trop. Med. Hyg.*, **46**, 449.

Idem and HADDOW, A. J.—(1952) "Uganda S. virus. A hitherto unrecorded virus isolated from mosquitoes in Uganda. (I) Isolation and pathogenicity." *Trans. R. Soc. trop. Med. Hyg.*, **46**, 600.

Idem and HORGAN, E. S.—(1952) "Vaccination by scarification with a combined 17D yellow fever and vaccinia vaccine." *J. Hyg., Cambridge*, **50**, 376.

Idem, KITCHEN, S. F. and HADDOW, A. J.—(1952) "Zika virus (I). Isolation and serological specificity." *Trans. R. Soc. trop. Med. Hyg.*, **46**, 509.

HADDOW, A. J.—(1952) "Field and laboratory studies on an African monkey *Cercopithecus ascanius schmidti* Matschie." *Proc. Zool. Soc. London*, **122**, 297.—(1952) "A review of the results of yellow fever protection tests of the sera of primates from Kenya." *Ann. trop. Med. Parasit.*, **46**, 135.

LUMSDEN, W. H. R., and VAN SOMEREN, E. C. C.—(1953) "Records of *Culex* species (*Dipt. Culicidae*) from West Nile District, Uganda; with notes on their behaviour." *Proc. R. ent. Soc., Series B*, **22**, 19.

ROSS, R. W., HADDOW, A. J., RAPER, A. B., and TROWELL, L. H. C.—(1953) "A fatal case of yellow fever in a European in Uganda." *E.A. Med. J.*, **29**, 1.

Animal-Borne Diseases in Malaysia

91. The work of the Colonial Office Scrub-Typhus Research Unit based on the Institute for Medical Research, Malaya, comprises the general investigation of the animal reservoirs and the potential vectors (other than mosquitoes) of diseases in Malaysia. The original emphasis on scrub-typhus has served its purpose as a directive of effort, and the emphasis is now shifting to other infections which involve animal reservoirs. Proposals are being made to stabilise the Unit by administering it from, and incorporating it in, a new Division of Virus Research and Medical Zoology of the Institute. The revised objective of the Unit is thus a continued study of animal ecology with special reference to medical problems. The native forest is regarded as a potential reservoir of parasites and pathogens and is being compared with occupied and deforested land, with reference to all the animal infections and parasites which may be communicable to man, but with special emphasis on the yellow-fever hazard and on other virus infections (especially the encephalitides and dengue), leptospirosis, jungle-tsutsugamushi, and enzootic filariasis. The Unit is in close collaboration with the Institute's Divisions of Entomology, Malariology, and Pathology, and with the research unit from the U.S. Army Medical Service Graduate School, Washington, D.C., shortly to have a semi-permanent base in the Institute. It supervises the animal houses of the Institute and an additional

grant, to be renewed, has been made by the Colonial Office to provide a Superintendent. As from 1st January, 1952, the Malayan Government has borne half the expense of this Research Scheme, and it has now granted funds for a new animal house, essential for the expanding work on viruses. The Malayan Government is also building a new laboratory block to accommodate the unit, the Institute's Virus Laboratory, and the U.S. Army research unit.

92. Banditry has prevented the extension of the work to include the forest canopy. Monkeys and other potential reservoirs in the environs of Kuala Lumpur are being studied. Troops of macaques in the Lake Gardens area seem to consist of 8–12 led by an old male and including 2–4 adult females and up to 6 young of various ages. Two or more troops are sometimes seen foraging together. The range of a troop appears to be about a kilometre in diameter. Long-term experiments involving the repeated recapture of marked animals are producing valuable data. The breeding rhythm of nocturnal animals has been related to the phase of the moon and to rainfall, and the data have been published. Male animals generally show an annual cycle of testicular development. The forest rats show a pronounced increase in testis weight during the middle of the year, but the domestic and semi-domestic rats show little or no such effect while the House Shrew is distinctive in showing a cycle of opposite phase. Studies of feeding habits continue. Observations on stomach-contents show that many ground-rats living in secondary growth eat very large numbers of ants and termites.

93. During the year 4,300 mammals and other hosts, with their parasites, were examined, bringing the total up to 21,151. The great richness of the parasite fauna, more than 90 new species of trombiculid mites alone having been encountered, has demanded much taxonomic study. In collaboration with Lt.-Col. Traub (U.S.) and Mr. H. Womersley (of the South Australian Museum), 30 new species of trombiculids and 11 nymphs and adults are being described. Data on the feeding-times of parasites have accumulated and will allow estimates of parasite-populations to be made from the field data. It is proposed to publish the parasitological studies in the Institute's *Study* series.

94. Both officers of the Unit spent 7 weeks in North Borneo in May-June on a joint Anglo-American project financed by the Surgeon-General's Office in Washington. A chemical mixture M-1960, applied to clothing and intended for protection from insects, was proved to give full protection against both water- and land-leeches. A survey was made of the economic importance and bionomics of leeches; further studies are to continue in Malaya, including trials in the protection of security forces in field conditions. The use of protective ointments and the possibility of control by spraying residual poisons were explored by pilot experiments. In addition, human sera, cultures of kidney-tissues of small animals, bacterial cultures from skin infections, and many animals and parasites, were collected for various investigations of encephalitis, leptospirosis, bacterial resistance to antibiotics, and the potential vectors of disease. The serological and bacteriological tests are being carried out in Washington.

95. In January, 1953, a party from the Unit, accompanied by Mr. J. Wyatt-Smith, the Forest Botanist, and Mr. M. W. F. Tweedie, the Director of the Raffles Museum, paid a second visit to islands in the Malacca Straits. Jarak island was briefly surveyed in 1949 (*Colonial Research* 1940–50, p. 98); this time, a small party of assistants was left on the island for marking and releasing rats, with the intention of estimating populations.

The Sembilan islands near the Malayan coast were also investigated. The rats there were infested by the vector, *Trombicula deliensis,* and by *Gahrliepia fletcheri.* The Indonesian Government very kindly authorised a similar investigation on Berhala island, near the cost of Sumatra. The picture here very closely resembled that on Jarak, *T. deliensis* and *Walchia rustica* being present in large numbers; but the rats, although overcrowded, were not as numerous as on Jarak and appeared to be identical with the wood-rat, *R. r. jalorensis,* of the mainland.

Publications

AUDY, J. R.—(1951) "Trombiculid mites and scrub itch." *Aus. J. Sci.,* **14,** 94—(1951) "Trombiculid mites infesting bats in Malaya, with descriptions of three new species." *Bull. Raffles Mus.,* **25,** 109.—(1952) "The language and behaviour of animals and scientists." *Malay Nat. J.,* **7,** 151. —(1953) "Strolling on the ceiling." *Ibid.* **7,** 182.

Idem and HARRISON, J. L.—(1952) "Field trials of repellants and poisons against aquatic and terrestrial leeches in British North Borneo, 1952. (A report of research investigations supported by funds supplied by the office of the Surgeon-General, U.S. Army)". Mimeographed Report, distributed from Washington, D.C.

HARRISON, J. L.—(1952) "Food of a binturong." *Malay Nat. J.,* **7,** 39—(1952) "Millepede Swarms." *Ibid.* **7,** 41.—(1952) "Introducing bats." *Ibid.* **7,** 56.—(1952) "Fruit bats." *Ibid.* **7,** 125.—1952) "Moonlight and the pregnancy of Malayan forest rats." *Nature,* Lond., **170,** 73.—(1952) "Breeding rhythms of Selangor Rodents." *Bull. Raffles Mus.,* **24,** 109.—(1953) "Insect-eating bats." *Malay. Nat. J.,* **7,** 191.

TRAUB, R., WISSEMAN, C. L., AND AUDY, J. R.—(1952) "Preliminary observations on a repellant for terrestrial leeches." *Nature,* Lond., **169,** 667.

96. The following summary (paras. 97–100) of the investigations made and financed by the Medical Research Unit of the United States Army Medical Service Graduate School, with its headquarters at the Institute for Medical Research, Kuala Lumpur, has been contributed by Dr. Joseph E. Smadel, who directs the Unit.

97. The U.S. Army Medical Research Unit (Malaya), which has been working closely since 1948 with members of the staff of the Institute for Medical Research, Kuala Lumpur, undertook little new field work during 1952. Efforts were concentrated on completing certain studies which were under way, in arranging for replacement of persons who had finished their tours of duty in the Army, and in undertaking preliminary exploration on problems that might be profitably pursued in the future.

98. *Japanese encephalitis.* Serological studies designed to determine the incidence of infection with the virus of Japanese encephalitis among the peoples and animals in Malaya as well as in human beings in North Borneo have been continued since 1951, when this agent was recovered for the first time in South-East Asia from the brain of a patient with this disease who died near Kuala Lumpur. Three-quarters of the sera from life-long residents of Malaya (9 Sakai, 52 Malays, 46 Indians, and 49 Chinese) contained appreciable amounts of neutralizing antibodies against Japanese encephalitis virus; there was no difference in the incidence of positive sera among the four races. In contrast, only four positive sera were found among the 74 specimens from non-Asians who had lived in Malaya from six months to two years. Certain of the human sera which neutralized Japanese encephalitis virus also possessed some capacity to protect against the closely

related Murray Valley and West Nile viruses. However, it is assumed that this represents an immunological cross-reaction, and that the Japanese agent is the sole member of this family of viruses present in Malaya. Almost all Malayan pigs, bovines, and equines whose sera were examined contained neutralizing antibodies for Japanese virus as did an appreciable proportion of the dogs and goats. Similar studies carried out on 54 sera obtained from indigenous peoples of North Borneo living in an area from Labuan to Kinabalu revealed that 67 per cent. possessed neutralizing antibodies against Japanese encephalitis virus. Here, too, a few of the positive sera neutralized to some extent the Murray Valley and West Nile viruses, but this also appears attributable to group reaction.

99. *Drug Resistance of Staphylococci from North Borneo, Malaya, and U.S.A.* The increasing frequency with which drug-resistant strains of micro-organisms are being encountered in many parts of the world is the subject of general concern. Resistant organisms are recognized in those geographic areas where drugs and antibiotics are commonly employed as therapeutic agents. It appeared desirable to compare the incidence of resistant strains in such areas with that in other places where antibiotics are used less frequently. Accordingly, strains of haemolytic staphylococci were obtained during 1951 from persons with minor cutaneous lesions in Washington, D.C., Kuala Lumpur, and North Borneo, where penicillin may be said to be used intensely, moderately and rarely, respectively, in medical practice.

Forty-one per cent. of the 68 strains from Washington were resistant to penicillin, i.e., at least one unit of penicillin was required to inhibit growth of the organisms in a standard sensitivity test employing serial dilutions of antibiotic in fluid medium. Eleven per cent. of the 26 strains from Kuala Lumpur and none of the 44 strains from Borneo were resistant to penicillin. All 138 strains were found to be equally sensitive to the new antibiotic carbomycin (Magnamycin-Pfizer), being inhibited by less than one gamma per millilitre. Carbomycin had not been used clinically in any of these selected areas at the time the cultures were collected. Thus, in this study the proportion of antibiotic resistant strains of staphylococci encountered in a given geographic area was shown to be correlated directly with the extent to which the antibiotic had been employed in that area.

100. *Studies on Trombiculid Mites.* Preliminary field studies in 1949 near Kuala Lumpur had suggested that application of miticides to terrain provided excellent control of the chigger vectors of scrub-typhus, *Trombicula akamushi* and *T. deliensis.* However, because of ecological changes in the study area, and other reasons, the work was discontinued until a suitable location could be found. Through the efforts of the American group and the Colonial Office Scrub-Typhus Research Unit in Malaya, several promising sites have been located in the Jesselton and Mount Kinabalu areas of North Borneo and the investigations on miticides will be resumed during 1953. Although scrub-typhus has not been recognized in North Borneo, because of the prevalence of *T. akamushi* and *T. deliensis* members of the 1953 field team (composed of personnel from the British and American units) will search for the disease in patients and for *Rickettsia tsutsugamushi* in chiggers and rodents.

The trombiculid mite fauna of Malaya and Borneo is far richer than previously suspected. Eleven new species of *Trombicula* have been recently collected in these countries. Most of these chiggers are in the so-called " tsutsugamushi group," i.e., the subgenus *Leptotrombidium.* Inasmuch as the

U.S. Army Medical Research Unit has earlier reported the occurrence of *Rickettsia tsutsugamushi* in a species of *Euschongastia* collected in the jungle, it is of interest to note that during the course of the current surveys six new species of *Euschongastia* have been discovered.

Relapsing Fever Research in East Africa

101. From April to August Dr. G. A. Walton was mainly engaged in constructing extensions to his laboratory at Kerugoya, Kenya. He was joined by Mr. K. L. Cockings, as Field Assistant, in July. Visits were made to the South Nyeri Kikuyu Reserve to obtain samples of living *Ornithodoros moubata* ticks and to discuss with the Health Authorities means of distributing "Gammexane" powder to tick-infested huts in that area. During August and September the unit made surveys of Relapsing Fever in the Usambara Mountains area of Tanga Province in Tanganyika, and the Teita Hills and Kwale District in Kenya. It has previously been reported that although some 2,800 tick-infested houses occur in the Kwale District of Kenya the incidence of Relapsing Fever is normally negligible, since 93 per cent. of the ticks feed on domestic fowls in preference to man. It was suggested that the occasional small but severe epidemics of Relapsing Fever that occur there might be caused by the introduction of infected ticks from the direction of the Usambara Mountains in Tanganyika. That assumption now appears to be correct; for not only was that highland area found to be very heavily tick-infested, but it also resembled the other endemic foci of Relapsing Fever previously studied in Kenya, in that the ticks fed very largely on man in preference to domestic fowl, and large numbers of Africans travel through Kwale District from the Usambara Mountains to Mombasa.

102. Only 6 cases of Relapsing Fever were reported in 1952 from the 1,500 square miles of Usambara highlands. The existence of so large a tick-infestation as was revealed by this survey, viz., an estimated minimum number of 25,000 infested huts yielding an average catch of 33 ticks, was unsuspected. Probably this vast reservoir of ticks and of infection had escaped recognition largely owing to a very high level of immunity to Relapsing Fever possessed by the African population; and also, perhaps, to the non-recognition of the clinical syndrome and to incomplete recording of laboratory findings. Twenty-two unreported cases were found in the records at the Bumbuli Mission Hospital; spirochaetes were recovered from ticks collected in seven widely spaced villages; African strangers visiting the area are known occasionally to acquire very severe infections.

103. As the survey progressed from Kwale District up to and into the Usambara Mountains, the higher became the proportion of the ticks which fed on human blood in preference to that of domestic fowls, as is shown by the following data derived from precipitin-tests of blood taken from the stomachs of the ticks, that were undertaken by Mr. Bernard Weitz at the Lister Institute in London.

Area of Sample	Number of tick blood-meals tested	Percentage showing choice of human blood in preference to domestic fowl
1. Kwale District Kenya	150	7
2. Mwakijembe, on Tanganyika side of boundary	54	29
3. Daluni. N.E. Usambara Foothills	100	41
4. Lower S.E half of Usambara Mountains ...	140	74
5. Higher N.W. half of Usambara Mountains	106	83
6. Kenya Highlands, Nyeri and Teita Districts	124	99

104. From October onwards the activities of the Unit were confined to Kerugoya in making a study of data derived from the Usambara area, and in preparing a report on native rural housing for local publication based on a study of the 3,400 native dwelling places so far examined. It is planned to make surveys in the Lake Province of Tanganyika between April and October. 1953.

Preparation of Precipitin Sera

105. Laboratory and field investigations in the preparation of precipitating antisera against sera of various animal species were continued by Mr. B. Weitz at the Lister Institute of Preventive Medicine, London.

A special study was made of the sera of the African species of the family Bovidae in view of their importance in regard to tsetse fly meals and also because of the great difficulty in distinguishing the serum of the different species of this family by means of the ordinary precipitin test. Rabbit precipitating antisera against any single serum give cross reactions with the sera of most bovid animals, but the specificity of antisera can be very considerably improved by the "cross-immunisation" technique which consists in preparing the antisera in related bovids instead of rabbits. By this means some very useful and specific antisera were obtained, as already reported (this Annual Report for 1951–52, para. 94); but it was later found that when the the range of antisera was extended by the inoculation of calves, sheep, goats, gazelles, dikdiks, duikers and a reedbuck with the serum of various other bovids, the results were extremely variable. It became evident that, in order to put the method on a practical basis, the large numbers of animals required and the variety of species to be inoculated would be very costly and technically difficult. Nevertheless, these antisera proved useful for the identification of a number of blood meals of *Glossina morsitans* and the results obtained are being studied in relation to the movements of game through the area from which the flies were caught.

106. A completely new technique for the identification of blood meals of closely related species is now under thorough investigation. When normal rabbit red blood cells (after treatment with tannic acid) are coated with serum proteins from a given species of animal, they are agglutinable by an antiserum prepared against these proteins. This reaction, like the precipitin reaction, is not very specific, but its inhibition by a solution of one of the serum proteins under test, is relatively specific. In practice, the unknown blood is added to a series of agglutinating species antisera, A, B, C, D, etc., which are then tested against a series of red cell suspension, coated with the respective serum protein from species, A, B, C, D, etc. The blood meal is identified according to the particular system it inhibits. The test is only valid under certain precise conditions and a considerable amount of investigation must be made before its routine application.

107. The identification of blood meals by the precipitin test was continued on a large scale. During the year nearly 30,000 tests on over 5,200 blood meals were made. The blood smears sent in from the field were taken from a wide variety of insects in many parts of the world. Thus 525 blood meals from *Glossina morsitans* (Dr. C. H. N. Jackson, Chief Entomologist, Shinyanga, Tanganyika) and 437 from *Ornithodorus moubata*, a tick transmitting relapsing fever, (Dr. G. A. Walton, Kenya) were examined. The remainder were from mosquitoes, including *Anopheles aquasalis* (2,239 meals from Major R. A. Senior White, Trinidad); *Aëdes aegypti* (230 samples) from Dr. C. Teesdale, Kenya, and Dr. W. H. R. Lumsden, Entebbe;

Anopheles funestus (212 samples) from Dr. M. T. Gillies, Tanga, Dr. C. C. Draper, Nigeria, and Dr. R. C. Muirhead-Thomson, Gold Coast; *Anopheles gambiae* (250 samples) from Dr. L. T. Bruce-Chwatt, Nigeria, Dr. Gillies, Tanga, Dr. Draper, Nigeria, Dr. Muirhead-Thomson, Gold Coast, and Mr. J. G. Halcrow, Mauritius. Other mosquitoes from various sources include *Anopheles marshalli, Culex thalasius, C. poicilipes* and *C. fatigans.* Blood smears examined for Mr. A. Smith (Filariasis Research, Mwanza), included *A. gambiae* (671), *A. funestus* (531), *A. longipalpis* (46), *A. rufipes* (20), *A. maculipalpis* (2), *A. r odensiensis* (2), *A. coustani* (1), *A. pharoensis* (21), *A. africanus* (98), *Taeniorhynchus africanus* (36), *T. uniformis* (23), *Mansonioides uniformis* (141), *M. africanus* (106), *C. annulioris* (102), *C. univittatus* (20).

108. It is gratifying to report that the collection of serum from wild animals under Mr. W. A. Hilton is now complete, and that what must be a unique collection of sera is now stored, in the freeze-dried state, at the Lister Institute. In this collection nearly all the more important mammals of East Africa are represented and in many cases several samples of the same species were obtained. During the last year more than 20 litres of serum have been received from over 30 different species.

Publications

WEITZ, B.—(1952) "The antigenicity of sera of man and animals in relation to the preparation of specific precipitating antisera." *J. Hyg.*, **50**, 275.—(1953) "Serological relationship of Hyrax and Elephant." *Nature*, **171**, 261.

Physiological Research at Makerere College.

109. Investigations during the year have comprised a continuation of the study of serum proteins, metabolic studies that included nitrogen balance and water content, haematological work, and studies by visiting workers.

110. *Serum proteins.* Miss M. W. Stanier has been chiefly responsible for this investigation. It will be recalled that a correlation was found among the local population between red blood count, and serum protein levels as determined by chemical measurement. The serum albumen rose and the total globulin fell as the blood count rose, the fall being apparently due to the fall in the beta globulin fraction. This work has been repeated, serum proteins being determined by electrophoresis instead of by chemical fractionation. The rise in albumen and fall in total globulin have been confirmed. The results of electrophoresis, however, indicate that the fall in the total globulin is due to a fall in the gamma fraction, not the beta. This apparent contradiction has been resolved by the finding that, if the "gamma" fraction is precipitated by ammonium sulphate as in the chemical determination, and the supernatant fluid dialysed to remove ammonium sulphate, a further precipitate appears, which is considerable in many African sera, but very small in European sera. If this is re-dissolved in buffer, and submitted to electrophoresis, it is found to contain a considerable amount of a protein behaving, electrophoretically, as a gamma globulin. By the chemical methods it would, of course, be estimated as beta globulin. It has been found that the sera of the Karamajong, a tribe reported to consume chiefly blood and milk, have higher mean values for albumen, and also for gamma globulin, than are found near Kampala. More than half of the Karamajong sera tested gave a thymol turbidity reading of more than "44". While there is no direct evidence about the prevalence of liver disease among these people, it would seem highly unlikely that liver lesions are at all common among them. They are a fine, alert set of people; their diet certainly contains much animal protein; one saw nothing resembling

Kwashiorkor among the children, and one case only among adults had enlarged liver and spleen, and anaemia. One cannot therefore but feel great reserve in accepting, without more proof, that high gamma globulin values and positive thymol turbidity tests are evidence of liver damage.

111. *Nitrogen balance and water content.* In this study of nitrogen balance, by Professor Holmes and Mr. E. F. Jones, in patients suffering from malnutrition, one of whom has been under observation for 2–3 years, it has been noted that all continue to retain nitrogen on a high protein diet, though they can be brought into equilibrium by lowering the nitrogen intake. The most puzzling feature is that, considered over long periods, the weight gains are much less than the apparent protein storage.

It is probable that cutaneous losses of nitrogen have previously been under-estimated. There is at present no method available for direct measurement of these over long periods. The most liberal interpretation of the probable cutaneous losses still leaves a good deal of nitrogen unaccounted for except by retention in the body. Attention has therefore been turned to the question of body water, using the method of McCance and Widdowson. This work is continuing. So far, one can say that the figures for controls are in reasonable agreement with those of McCance and Widdowson for normal people. For malnourished subjects, on the other hand, extracellular or intracellular fluid, or both, appear greatly increased. No detailed discussion can be undertaken here. But obviously protein might be retained without change of weight if water or fat or both are simultaneously lost.

112. One patient, who has been under observation since September, 1951, showed rather a remarkable change. He had severe liver damage (proved by biopsy). Until August, 1952, he had regularly excreted considerable amounts of urobilin in his urine. His blood count had remained in the region of 4·5 million per c.mm. and had been unaffected by iron, extract of whole liver, and vitamin B.12. For a year he had had no treatment but had consumed a high protein diet. In August, 1952, he suddenly ceased to excrete urobilin, and within a few weeks his red cell count rose to 6 million per c.mm., where it has since remained with only minor fluctuation. His liver has diminished in size, and become softer.

113. *Haematology.* A visit to Karamoja and a study (by Professor Holmes and Mr. Jones) of the Karamajong has been referred to above. The mean red blood count of adult male Karamajong is very significantly greater than that observed among adult males around Kampala, though both regions are about 4,000 feet above sea level. The Karamajong red cell count is, in fact, equal to that of Makerere students, and conforms to the expected figure for 4,000 feet. The haemoglobin is somewhat lower than both Makerere students and the Kampala group of Africans. These observations are of course relevant to the serum protein picture.

A small random series of 45 pregnant women at Mulago Hospital have been examined. No less than 16 of them had red cell counts below 3·7 million per c.mm. and less than 10g. per cent. of haemoglobin. Their serum iron and iron binding capacity have also been measured. The former falls, and the latter increases, as pregnancy progresses. As these findings are similar to those of Ventura and Klopper in England, it is not proposed to pursue the matter further.

114. Professor Holmes attended the C.C.T.A. Conference at Fajara, Gambia, in November, 1952, as a representative of the E.A. High Commission Territories. An informal Conference was held in February, 1953,

with representatives of the Institute Recherche Scientifique Africa Centrale (Belgian Congo). The discussions were highly profitable.

115. *Visiting workers.* Dr. Margaret Thompson, of the Medical Research Council, has continued her work on the digestive enzymes and serum protein of patients suffering from malnutrition, and on the feeding of children suffering from this condition. Part of this work was reported at the recent nutrition conferences held at Fajara, Gambia, by Dr. Holmes, in a paper, and as a demonstration. Since Dr. Thompson will be reporting separately, further details need not be given here. Dr. R. F. A. Dean and Miss R. Schwartz continued to work in the Department until January, 1953 ; laboratory space, an animal room, technical assistance and equipment have been placed at their disposal. Dr. Dean has published several papers, two of which were communicated at the Fajara conferences by Professor Davies of Makerere College. Professor H. Heller, Dr. H. Schnieden, and Mr. Blackmore, of the Department of Pharmacology, University of Bristol, spent three months in the department, the resources, both of the department and of the metabolic ward, being placed at their disposal for their study of the water metabolism of malnourished children and adults. Brief summaries by Dr. Dean and Professor Heller on their work appear elsewhere in this report.

116. Dr. R. F. A. Dean, of the Medical Research Council, has contributed the following summary of the investigation by himself and Miss Schwartz, referred to in the previous paragraph, which they have been making in Uganda since 1951, financed wholly by the Medical Research Council.

The main object of the investigation is to try to find cheap and reliable means of curing and preventing kwashiorkor. The biochemical data obtained appear to be of value in the objective diagnosis of the disease, and in following the effects of treatment. Treatment with milk proteins has been standardized and a few children have been treated successfully with mixtures of plant proteins. More work is needed, however, before the value of the plant proteins can be exactly assessed.

Studies of the growth and development of African children have begun ; they are regarded as essential to any endeavour to improve nutritional status, and have already shown that the application of American and European standards to African children is likely to be misleading.

The work in both fields is being linked as far as possible with similar work at other centres outside Uganda.

117. Professor H. Heller, of the Department of Pharmocology of Bristol University, has contributed the following summary (paras. 118–120) of the investigations that he and Dr. H. Schnieden, with the technical assistance of Mr. K. E. Blackmore and Miss J. Greaves, made on the water metabolism of malnourished children and adults during a period of some three months at Makerere College and the Mulago Hospital, Kampala, Uganda, aided by a substantial financial grant given by the Colonial Office at the recommendation of the Committee, from research monies provided under the Colonial Development and Welfare Acts.

118. *Oedema in adult Africans suffering from liver diseases.* Data on the water and mineral metabolism were collected from five adults with ascites and two adults clinically diagnosed as suffering from liver disease without ascites. Seven adult Africans without detectable liver or kidney dysfunction served as controls. Liver function—so far as ascertainable from thymol turbidity and bromsulpthalein retention tests—was highly abnormal in all but one of the patients with ascites and in the two patients without ascites.

Plasma volume and sucrose space were high in the ascitics, haematocrit values and renal sucrose clearance were low; plasma sodium concentration was normal or slightly raised; water diuresis was much depressed in patients with ascites but normal in the non-ascitic cases. The antidiuretic potency of plasma obtained by internal jugular puncture was estimated by the method of Ginsburg and Heller (1953), i.e., by intravenous injection into rats. It was high in four patients with ascites but low in a fifth man with this condition. It was also raised in a non-ascitic patient with an increased sucrose space and a bromsulpthalein retention of 39 per cent. (45 min.). It is doubtful however, even from the small series investigated, whether the state of the liver should be related to the plasma level of antidiuretic substance, since one patient with cirrhosis (diagnosed by biopsy) had a very low plasma level. Conversely, another patient with ascites had a very high plasma antidiuretic potency but almost normal liver function tests and, on biopsy, a histologically normal liver.

119. *Oedema in infants suffering from kwashiorkor.* Seventeen infants with kwashiorkor were investigated. All had low plasma protein concentrations and the A/G ratio was below one with one exception. All were slightly anaemic. Traces of protein in the urine were frequently observed; diuresis tests gave low results in 7 out of 17 cases. Haematocrits were low; plasma sodium concentration was much the same as in healthy white infants. Blood samples from an internal jugular vein were obtained from 13 children as soon as practicable after admission. On the assumption that antidiuretic potency in plasma from healthy infants who have not been deliberately dehydrated is so low that it cannot be detected by the assay method used, antidiuretic activity in kwashiorkor infants was raised in 11 out of 13 instances. Estimations of antidiuretic potency in plasma were repeated in 9 infants after they had been on a high protein diet for two to three weeks. A marked decrease in plasma antidiuretic potency after treatment was found in all cases in which it was high on admission.

120. It would thus appear that in both adult Africans with ascites and kwashiorkor infants with oedema, a rise of plasma antidiuretic potency due to increased secretory activity of the posterior pituitary gland may be a factor influencing water retention. However, since low antidiuretic values were found in some of these patients, it is unlikely to be the only or even the most important factor. Retention of sodium (for which some evidence has been obtained) may be of more significance. Further investigations, in particular on the renal function of Kwashiorkor infants, are needed to clarify the aetiology of oedema of nutritional origin in African patients.

Hot Climate Physiology

121. Dr. W. S. S. Ladell, Dr. R. A. Kenney and Mr. P. G. Phillips, of the Hot Climate Physiology Research Unit at Oshodi, Nigeria, have continued their investigations into the physiological principles of everyday life. A survey has now been completed of the energy cost of most of the everyday tasks of the farmer; and a start is being made on the purely industrial tasks, particularly the energy cost of head-carrying. It is found that head-carrying is extremely efficient until the load reaches 65 lbs.; but with further increases in load the energy expenditure rises rapidly, and the carrier is unable to continue without frequent long rests. At the same time the staple Nigerian foods have been analysed, and the body-building and energy-providing value of the standard Nigerian working-man's diet is now known in fair detail: the Unit has not, however, performed any vitamin assays.

122. A series of carefully designed experiments has exploded the old fallacy that frequent drinking is bad; both from the physiological point of view and from the point of view of water economy it is better to take frequent small drinks than a few large ones of the same total volume. The investigation of the limiting factors for work under difficult conditions is being extended with the installation of a wind-tunnel and experiments are starting in which the effect of working in winds up to 15 m.p.h. will be followed. Academic problems have also been studied, in particular the normal working of the kidney in Nigerian subjects, which has been shown to be somewhat different from that of expatriate subjects; it is believed that this may be conditioned by differences in diet.

123. Earlier experiments on the West African's reaction to stress led to tests on Nigerian subjects of the hormone "A.C.T.H.", widely used for rheumatic and other complaints in Europe and America; the reaction of these subjects to A.C.T.H. suggested that Nigerians are relatively insensitive to this hormone: the reasons for this are under investigation. The Unit has continued to send samples of blood to the United Kingdom for Rh and for other special grouping of anthropological interest.

124. Visiting Scientists have contributed largely to the work of the Unit. One, Dr. N. A. Barnicot, collaborated with the A.C.T.H. tests. Another, Dr. M. L. Thomson, investigated the sweat gland distribution of Nigerian and expatriate subjects under identical conditions. He found no major differences. Preliminary tests, however, showed the value of a deeply pigmented skin in protecting the deeper tissues from ultra-violet light.

125. At the request of service authorities in the United Kingdom a number of footprints, taken on a special machine, have been obtained from African subjects; these will be useful in designing physiologically correct footwear. Some tests have also been carried out on the prevention or cure of prickly heat by medicated soaps.

Publications

LADELL, W. S. S.—(1952) "Applied Physiology in Nigeria." *W.A. Med. J.*, **1**, 35.—(1952) "Life and work in hot humid climates." *U.N.E.S.C.O. Courier*, June.

KENNEY, R. A.—(1952) "The effect of hot, humid environments on the renal function of West Africans." *J. Physiol.*, **118**, 25.—(1952) "The effect of exercise in hot humid environments on the renal function of the West African." *Ibid.*, **118**, 26.—(1952) "Plasma-urea levels in West Africa." *Lancet*, **2**, 1930.

BARNICOT, N. A.—(1952) "Daily urinary 17-ketosteroid output of African Negroes." *Lancet*, **1**, 893.—(1952) "Albinism in South-Western Nigeria." *Ann. Eugenics*, **17**, 38.

Idem and LAWLER, S. D.—(1953) "A study of the Lewis, Kell, Lutheran and P blood group systems and the ABH Secretion in West African Negroes." *Amer. J. phys. Anthrop*, **11**, 83.

Leprosy.

Nigeria.

126. Although the Committee has not been directly concerned with leprosy research in Nigeria, which is financed by the Government of Nigeria, it is considered appropriate to include here the report by Dr. John Lowe, Research Officer at the Uzuakoli Leprosy Settlement, on the important work done by

him during the year, which comprised mainly treatment and immunology. The Colonial Office, on the recommendation of the Committee, recently gave a substantial grant from research funds towards the cost of additional laboratory equipment and a guest-house for trainees or visiting scientists.

127. *Treatment.* Pharmacological and therapeutic studies of sulphones in general, and Dapsone (diamino-diphenyl sulphone) in particular, summarised last year, showed that Dapsone in small doses given orally is an effective, simple, safe and widely practicable form of chemotherapy of leprosy. It is now being used extensively in many countries. Observations on relapse after sulphone treatment have continued. In lepromatous cases, clinical relapse has not been seen, but bacteriological relapse has occurred in a few, and unexpectedly has been more common in tuberculoid cases. There is no indication, however, that relapse will constitute a serious problem.

128. Studies of *paracetamidebenzaldehyde thiosemicarbazone* (TB1) in treatment have continued intensively in 160 patients over 27 months. The good results previously recorded have been confirmed. They have merited the following opinions: (1) TB1 is as effective as sulphone, and may be superior in some ways. (2) A serious toxic effect has been seen in 3 of 160 cases, namely, acute agranulocytosis, in which, if diagnosed early and if large doses of penicillin are given, recovery is rapid ; otherwise death may occur. This complication appears early, during the first six weeks or not at all. (3) Apart from this, TB1 is very well tolerated, in most cases rather better than sulphones ; allergy has not been seen, and complications, viz. reaction, neuritis, iritis, etc. have been rarer and milder. (4) The clinical and bacteriological response has been good in almost every case, and some patients have already been discharged clinically inactive and bacteriologically negative. (5) Relapse has not yet been seen, but discharged cases are still few and the period short. (6) Treatment must be given at least once daily ; given twice-weekly it is ineffective. (7) This fact, as well as the acute agranulocytosis seen, makes TB1 in treatment much less widely practicable than Dapsone ; moreover its cost is much higher. (8) TB1 is extremely useful in those who become allergic to sulphones, and in those who for other reasons (e.g. frequent "reactions", psychosis) have difficulty with Dapsone. TB1 can now be regarded as an effective and practicable treatment for leprosy, though close medical supervision during the first few weeks is advisable.

129. A clinical trial of *Isoniazid* (Isonicotinyl hydrazide ; I.N.H.) was made in 27 cases during a period of six months, with doses up to 300 mg. a day. The response was clearly much less than with sulphone or TB1, there being no clear-cut evidence of a beneficial action. It may prove some value in the treatment of complications, but even this is not definite. In the combined use of the two therapeutic agents of proved value, sulphone and thiosemicarbazone (TB1), the results were no better than with either given alone, while toxic effects were greater.

130. The action of A.C.T.H. and cortisone on the acute manifestations of leprosy was studied in 38 cases for periods up to 4 months ; these included lepromatous reaction, tuberculoid reaction, neuritis, iritis, and cases of allergic sulphone dermatitis. The conclusions were that while these manifestations can be very readily controlled by hormone treatment, there is a grave danger of aggravating the underlying disease, particularly in those receiving repeated short courses of treatment, and even of aggravating the particular symptoms to alleviate which the hormone has been given. Thus the early results are good, and the late results all too often bad ; and attempts to minimize the latter by modified dosage and by energetic chemotherapy during hormone treatment have met with little success. Nevertheless, in two serious complications encountered in the treatment of leprosy, the results are striking and

are usually attained with such small doses that hormone treatment is fully justified. They are, firstly, sulphone sensitivity, with drug fever, dermatitis, and hepatitis, and, secondly, acute and subacute leprous eye inflammation; in these the local use of cortisone appears to be effective and safe, and is to be preferred to injection. Otherwise hormone treatment of leprosy is usually contraindicated. In some cases of acute neuritis, carefully selected as showing only mild residual leprous infection after chemotherapy, one short course might be justified, but other methods of treatment appear preferable.

131. *Immunology.* Workers in other countries have reported that tuberculous infection (as shown by a positive tuberculin test) is usually accompanied, even in healthy persons with no contact with leprosy, by a positive lepromin test which is generally regarded as indicating relative immunity to leprosy; and, further, that in persons who are both tuberculin-negative and lepromin-negative, the giving of B.C.G. makes them both tuberculin- and lepromin-positive. Some have therefore considered that B.C.G. probably produces some immunity to leprosy, and have recommended its use to "immunize" healthy persons, particularly children living in contact with lepers. The subject has been studied intensively by the Research Unit. Tuberculin and lepromin tests were done in 359 healthy persons. The findings have given very strong evidence that a positive tuberculin test (produced by a tuberculous infection) is usually accompanied by a positive lepromin test presumably due to the same cause, and have confirmed that B.C.G. given to healthy persons who are lepromin- and tuberculin-negative usually makes them both lepromin- and tuberculin-positive. The evidence suggests that B.C.G. should possibly or probably be of value in prophylaxis. Supporting experimental evidence takes many years to collect; only a small amount is yet available, from South America.

132. The conception that tuberculous infection produces immunity to leprosy would help to explain many hitherto obscure facts about the epidemiology of leprosy, for example, why leprosy has disappeared from certain countries and persisted and spread in others. It might throw much light on the epidemiology of leprosy in West Africa, and have important practical application in the control of leprosy and tuberculosis in Nigeria and elsewhere. The use of the two tests, and, in tuberculin negative persons, of B.C.G., has been studied in 366 cases of leprosy of different types. Here the findings are complex and not capable of brief presentation. They indicate that it is just possible that B.C.G. immunization might be of some value in improving the prognosis of cases under chemotherapy, for in some tuberculoid cases B.C.G. enhances the response to lepromin, and, in a few lepromatous cases, a negative lepromin is turned into a lepromin positive, though these changes have not so far been shown to improve prognosis appreciably. Further work continues; all healthy children of leprous parents, born in or brought to this institution, are being given B.C.G., and an attempt will be made to assess the value of this measure in the prophylaxis of leprosy.

Publications

LOWE, J.—(1952) "Acute agranulocytosis caused by TB1/698". *Leprosy Review*, **23**, 109.—(1952) "Acute agranulocytosis and thiosemicarbazone." *Lancet*, **2**, 831.—(1952) "A.C.T.H. and cortisone in treatment of complications of leprosy." *Brit. med. J.*, **11**, 746.—(1952) "Isoniazid in the treatment of leprosy." *Lancet*, **2**, 1012.—(1952) "The chemotherapy of Leprosy." Report presented at Leprosy Expert Committee, World Health Organization, Rio de Janeiro, November, 1952.

Goitre

Investigation in Nigeria

133. Dr. Dagmar Wilson, aided by a small grant recommended by the Committee, returned to Nigeria towards the end of 1952 to continue for a second period of three months her investigations of the incidence of endemic goitre. The Central (Bauchi) Plateau was again chosen as an appropriate area for the main enquiry, providing easy access to adequate clinical material, and good facilities for the air transport of laboratory samples ; other districts yielding obvious goitre and, in contrast, no goitre, were also visited.

134. Since adverse metabolic factors may contribute to the incidence of simple goitre, particular attention was directed to the customary dietaries and to the incidence of the clinical stigmata of malnutrition, more especially in the urban and rural schools in the Niger, Zaria, Kano and Bornu provinces. The ready assistance given by Dr. Constance Geary, Ph.D., Chief Woman Education Officer, Northern Nigeria, and her staff greatly facilitated this phase of the enquiry. The schools included boarding-schools for girls supported by Government or by the Native Authority, Senior and Junior Primary day schools, and mission and church schools. From these three types of schools, representative groups of girls, mostly from eight Northern races, were examined in the infant, middle and senior classes. In mixed schools a rapid survey of the boys was made for signs of nutritional deficiency. Of 284 schoolgirls aged 10–18 years from whom detailed clinical records were obtained, the stigmata of a poor nutritional condition were present in 11 per cent. Amongst other findings it was noted that dental caries varied inversely with the incidence of dental fluorosis ; being, as expected, low in the Niger and Bornu provinces where fluorine is abundant in many sources of water. Enlargement of the thyroid, visible at rest, was seen in 49 girls (17·2 per cent.) whose homes utilised drinking water known to come from an area of granite rocks and to be low in iodine. From the Ilorin province, where the school authorities supervise the provision of food at the mid-morning break, very favourable records were obtained. The conclusions drawn were that nutritional factors, other than lack of iodine, do not influence the incidence of goitre in Northern Nigeria.

The findings of the previous survey were confirmed, namely, that the areas of obvious goitre lay on granite, or were associated with granite outcrops in marine sediments or with drainage areas off granites, and such areas were mapped out in consultation with Mr. W. N. MacLeod of the Geological Survey of Nigeria. Hyperthyroidism (Grave's Disease) appeared to be rare.

135. Some evidence having been reported that other halides in drinking water, such as fluorine, may influence iodide excretion, ten representative samples of Plateau drinking waters were sent by air-transport for analysis by Professor Margaret Murray at Bedford College, London ; 9 had a low fluorine content, and one had none. Since the sulphone drugs are now being used extensively in the treatment of leprosy, and structurally resemble anti-thyroid drugs, lepers under treatment from many different areas were investigated, but no cases of goitre were found that could not be traced to a domicile in granite areas.

136. A new grade of vacuum salt, dendritic salt, has recently been introduced into the West African market ; it can be supplied iodized more cheaply than the uniodized coarse salt now in use, which requires more manual labour in its preparation, and proposals for fostering its use were discussed with the appropriate authorities.

Field Research Station, Fajara, Gambia

137. From the Field Research Station, Fajara, which will in future be designated the Medical Research Council Laboratories, Gambia, Professor Platt reports that the past year's work has been mainly concerned with: (*a*) work on nutrition, including its relationship to malaria; (*b*) the Second Conference on Nutrition under the auspices of the Commission for Technical Co-operation in Africa South of the Sahara (C.C.T.A.) on "Malnutrition in African Mothers, Infants and Young Children", and the Third Session of the Joint Food & Agriculture Organization (FAO) and World Health Organization (WHO) Expert Committee on Nutrition, both of which took place at Fajara in the autumn; and (*c*) expansion of the scope of the work at the Station to include studies of filariasis and schistosomiasis.

138. (a) *Nutrition, including its relationship to malaria.* The nutrition work at Fajara, as has been the case in the past, has included relevant work done at the Medical Research Council's Human Nutrition Research Unit in London, and teaching and advisory work in the Department of Human Nutrition of the University of London at the London School of Hygiene and Tropical Medicine.

139. The investigations into nutritional disorders reported last year have continued and the results were reported at the C.C.T.A. Conference. Communications by the staff were made on the following subjects: nitrogen and protein metabolism in Gambian infants; the effects on school-children of the administration of Animal Protein Factor; results of feeding Gambian diets to experimental animals; investigations by means of experimental work on animals, of factors, especially pregnancy and growth, contributing to the development of dietary liver damage; dietary studies made in the Gambia; investigations of methods of infant feeding and the behaviour of milk in the infant's stomach; demonstrations of the effects of poor diets on the dyspigmentation of hair such as is found in kwashiorkor, and of techniques such as paper chromatography and electrophoresis; and methods of determining the digestibility of foods. These will be published in the forthcoming Report of the Conference. Since the Conference, further studies have been made on nitrogen metabolism by Dr. B. M. Balfour and Drs. O. and R. M. Lindan; the results await analysis.

140. Dr. F. E. Byron has continued the study of methods of determining the amino-acid content of tropical foods. One of the main problems has been the extraction of proteins from foodstuffs such as cereal grains, and methods employed until recently have, at best, failed to extract as much as half of the total protein. However, he is now able to extract 90 per cent. of the protein from the grain, using a solution of an alkyl aryl sulphonate detergent. This material can be readily purified, and the various proteins may be separated by electrophoresis on filter paper, employing a technique devised at the Human Nutrition Research Unit. Considerable progress has been made in determining quantitatively the amino-acids obtained after hydrolysis of proteins which may be separated on as few as five filter paper strips, using the one-way chromatogram technique.

141. After they had isolated and identified γ-methylene glutamine and γ-methylene glutamic acid from groundnut plants, Dr. J. Done and Dr. L. Fowden (a former member of the staff of the Unit) noted the occurrence of a third unsaturated amino-acid in extracts of groundnuts. This compound has been investigated and a small quantity isolated in pure form. The results indicate that it is α-methylene— γ-amino-butyric acid, and that it is formed by α-decarboxylation of γ-methylene glutamic acid. The especial interest

of these three new substances lies in their analogy to glutamine, glutamic acid and γ-amino butyric acid, and to asparagine, aspartic acid and β-alanine.

142. At the Applied Nutrition Unit, Miss M. W. Grant has been mainly responsible during the past year for dealing with enquiries from officers in the field, many of which have been concerned with field investigations and related matters. Publications concerned with field research, mostly in stencilled form, are available from the Applied Nutrition Unit; these include a memorandum on its functions and a list of liaison officers appointed for the various colonial territories.

143. *Malaria.* Complete analyses of recent surveys of the state of nutrition and malaria infection by Dr. I. A. McGregor at Keneba and neighbouring control villages in the Gambia are not yet available, but it is clear that the combination of the administration of Daraprim (25 mgm. for adults and proportionately lower doses for children) given in May, June, September and November, and spraying with BHC (at a rate calculated to deposit 20 mgm. of insecticide per square foot) in June, September and November failed to control malarial infection. Of the 50 children examined periodically throughout the year, 4 per cent. showed malaria infection in June, 56 per cent. in September, and 50 per cent. in November. The reasons for this are under investigation.

144. (*b*) *C.C.T.A. Conference and Joint F.A.O./W.H.O. Expert Committee on Nutrition.* The Second Conference on Nutrition under the auspices of the C.C.T.A. included a series of papers, demonstrations and discussions on clinical aspects, pathology, biochemistry, dietetics, and the prevention and treatment of nutritional disorders in mothers, infants and young children. Professor Platt presided and Dr. B. M. Balfour, Drs. O. and R. M. Lindan, and Dr. I. A. McGregor took part; other members of the staff of the Station assisted with demonstrations and the running of the Conference. Reference is made above (para. 139) to the contributions of the staff of the Station, of the Medical Research Council's Human Nutrition Research Unit, and of the Department of Nutrition at the London School of Hygiene and Tropical Medicine.

145. The Conference was of considerable value in drawing attention to the effects of malnutrition as a public health problem; but it is the fact that it provided an opportunity for research workers from various parts of Africa to meet and discuss their work which entitles it to especial mention in this Report. It will prove to be a stimulus to further research and will lead to the application for the benefit of Africans of the results of investigations already made.

Apart from its intrinsic value, the Conference was an excellent preparation for the meeting of the Third Session of the Joint F.A.O./W.H.O. Expert Committee on Nutrition which immediately followed it, at which malnutrition of mothers, infants and young children was considered on a world basis. Included in the membership of the Joint Committee were representatives from East Africa, South Africa, Australia, Belgium, British West Indies, France, India, Italy, Portugal, the United Kingdom and the United States. Four members of the C.C.T.A. Conference served on the Joint Committee and the remaining delegates were invited to be present as observers. At the invitation of Her Majesty's Government, those members of the Joint Committee who were not delegates to the Conference attended as observers.

146. It was clear from the evidence considered during both meetings that shortage of protein in the diet is a common deficiency in young children,

and that when a diet is deficient in protein and has also a relatively high proportion of carbohydrate a syndrome which is known by various names, including kwashiorkor, develops. One important conclusion, not hitherto generally recognised, to be drawn from the evidence produced at the Conference is that mothers of malnourished infants may themselves be seriously affected and indeed some have been reported as suffering from kwashiorkor. Considerable success has attended the efforts of some workers to treat severe as well as relatively mild cases of kwashiorkor but a satisfactory solution for its prevention has not yet been devised. It is, however, beginning to be recognised that more attention must in future be paid to the nutrition of mothers where malnutrition of children is prevalent, and that such efforts as were made by the Nutrition Field Working Party at Geneiri—i.e. to raise the general level of agricultural production, including food, should be made wherever there is malnutrition in Africa and other parts of the world.

147. Amongst the various recommendations made to Governments represented at the C.C.T.A. Conference was one for setting up means by which results of researches and information on nutrition could be exchanged between member Governments. Already from the Applied Nutrition Unit at the London School of Hygiene and Tropical Medicine liaison has been established between various British Colonial Territories, and it has been agreed that a similar arrangement should be made between member Governments. Professor Platt, who directs the Applied Nutrition Unit, has been nominated as the British representative in this new organization.

148. (*c*) *Expansion of the scope of the work to include studies on filariasis and schistosomiasis.* During the year four visiting workers have been accommodated for varying lengths of time at the Station, and one of the Station's staff has assisted in work on filariasis. Dr. Hawking paid one visit to the Station and, during the rest of the year, Dr. J. A. McFadzean continued the work under his direction. The epidemiology of infections by *W. bancrofti* and *A. perstans* was studied in three typical villages situated on the sea coast, near swamps, and in the interior ; in all three, high rates of infection by both worms were found. The infection is rare in young children under five years of age, but becomes increasingly common until the age of 20, after which the rate changes little. In the Gambia, elephantiasis is restricted to about one per cent. of adults, but it is much more common in some villages in the adjacent French territory of Casamance. In collaboration with the French medical authorities a visit was paid to some of these villages to begin investigations into the reasons for this differing incidence.

149. Treatment of elephantiasis of the leg was also studied Adrenocorticotropic hormone (A.C.T.H.) had no appreciable effect either upon the lymphstasis or upon the overgrowth of elephantoid tissue. Rest in bed for one month and tight bandaging reduced the size of the affected limb by half, but the reduction was gradually lost when the patient again became ambulant. This suggests that the reported success of various unorthodox treatments has been due mainly to hospitalisation and rest in bed. As previously reported by other workers, arsenamide, an arsenic compound, is very effective in killing or sterilizing the adult worms of *W. bancrofti*. Unfortunately it may have a toxic action upon the liver, causing jaundice or even necrosis. It is therefore recommended that this drug should only be used in hospital under close supervision, and on patients whose livers have been well fortified by a high protein diet.

150. The well-known periodicity of *Mf. bancrofti* has also been studied. Previous work by Hawking and Thurston showed that the absence of microfilariae from the peripheral blood during the daytime is due to their accumulation in the small vessels of the lungs. Dr. McFadzean has found that, if

patients are given oxygen to breathe during the night, the microfilariae mostly return from the peripheral blood to the lungs. Work in collaboration with Dr. Hawking showed that the same result is produced if the patients take vigorous exercise. Alterations in the acid-base balance of the blood do not affect the distribution of the microfilariae.

151. Preliminary studies were made on the mosquitoes which may transmit *W. bancrofti* in the Gambia. An insectary was built for the breeding of mosquitoes and, in collaboration with Dr. Bertram (see para. 153) small batches of *Aëdes aegypti* and *Anopheles gambiae* were bred. Identification in the field of the vectors of human filariasis is greatly complicated by the presence of a filarial infection (*setaria labia torapillosa*) in domestic cattle. The adult worms of this species live in the peritoneal cavity; the microfilariae occur in the blood and are non-periodic. The transmission of this worm to unnatural hosts, e.g. goats, sheep or horses, has been shown in Korea and Ceylon to cause curious paralyses, due to the migrations of the worm through the central nervous system. Such paralyses have not yet been encountered in the Gambia; but clearly the presence of filarial worms in mosquitoes caught near native villages does not prove that these mosquitoes transmit the human infection, unless it can be proved that such worms are human in origin and not animal.

152. Dr. D. S. Bertram of the Department of Entomology, London School of Hygiene and Tropical Medicine, visited the Station during July-September, 1952, and began investigations on the insects of the Gambia in relation to malaria and filariasis. His work was closely integrated with that of Dr. McGregor on malaria control at Keneba (see para. 143) by house treatment with BHC. Considerable number of anophelines were found to be resting in treated houses about three months after the application of BHC; from preliminary observations it appeared that *Anopheles melas* formed the greater part of this mosquito population and that *A. gambiae* had not become re-established in large numbers.

153. Dr. Bertram first collected mosquitoes at rest in huts and coming to bite bait-boys indoors and outdoor in the villages. Later, collections were made of mosquitoes biting cattle at night; a little time was spent collecting mosquitoes on a tree-platform in the secondary forest near a village. Certain monkeys and the domestic cattle of the Gambia are known to harbour a filarial infection and it was of interest to see if the mosquitoes biting man and cattle were of a different species from those frequenting tree-tops and possibly feeding normally on monkeys. It would appear from the results obtained that the same range of mosquito species, including *A. gambiae* and *A. melas* and certain common Culicine mosquitoes, are naturally feeding on man, cattle and possibly the monkey or some other hosts frequenting the secondary forests. There is scope for work on the possible role of these mosquitoes as vectors of the different filarial worms in the mammals. Although there may be no question of the animal filariae being pathogenic to man, it may be important to be certain that infective filarial larvae found in mosquitoes at rest in huts—for example, in *A. gambiae* and *A. melas*—are of *W. bancrofti*, and not of species from other hosts on which the mosquitoes have fed on a previous occasion.

154. Dr. B. O. L. Duke, a Colonial Medical Research student working under the direction of Professor J. J. C. Buckley of the London School of Hygiene and Tropical Medicine, spent five months at Fajara. He surveyed two areas for *Schistosoma haematobium* and found two widely different rates of incidence in children aged from 3–15 years, even though the groups were little more than a mile apart. In one area, on swampy ground near

the river, the incidence was about 10 per cent., and in a village away from the river with isolated ponds the rate was about 70 per cent. Two probable snail vectors were found—*Bullinus (Pyrogophysa) forskali* and *Physopsis africana.* The disease was relatively mild and it was difficult to assess the effects of infection in view of the many other ailments from which the children suffered. Since transmission is seasonal, taking place during and soon after the rains, and infection is contracted in small laterite ponds at the head of the rice swamps, it is thought that molluscides might profitably be used as a means of control.

155. Dr. W. Minning of the Tropeninstitut, Hamburg, was given facilities for the study of serological methods for the diagnosis of filarial infections. Dr. R. A. Webb, formerly a member of the staff of the Human Nutrition Research Unit, and now a member of the staff of the Agricultural Research Council, was given laboratory facilities to continue his investigations into the relationship between soil and plant nutrition.

Publications

BRAY, B.—(1953) "Nitrogen metabolism in West African children." *Brit. J. Nutr.*, **7**, 3.

DONE, J., and FOWDEN, L.—(1952) "A new amino-acid amide in the groundnut plant (*Arachis hypogaea*): evidence of the occurrence of γ-methyleneglutamine and γ-methyleneglutamic acid." *Biochem. J.*, **51**, 451.

MCFADZEAN, J.—(1952) "Congenital abnormality of foot." *Lancet*, **2**, 736.

MCGREGOR, I. A., HAWKING, F., and SMITH, Dean A.—(1952) "The control of filariasis with Hetrazan—a field trial in a rural village (Keneba) in the Gambia." *Brit med. J.*, **2**, 908.

Idem and SMITH, Dean A.—(1952) "A health, nutrition and parasitological survey in a rural village (Keneba) in West Kiang, Gambia." *Trans. Roy. Soc. trop. Med. Hyg.*, **46**, 403.

PAYNE, P. R., and RIVERS, D.—(1952) "An apparatus for automatic quantitative combustion of organic compounds to water." *Instrument Practice*, **7**, 120.—(1953) "A drop-counting fraction cutter for column chromatography." *Ibid.*, **7**, 206.

PLATT, B. S.—(1952) "Protein deficiency in Negro infants." *Brit. Med. J.*, **2**, 821 (Leading article).

RESEARCH WORK UNDERTAKEN AND FINANCED BY THE MEDICAL DEPARTMENTS OF COLONIAL TERRITORIES

156. The following is a summary of relevant information furnished by Colonial Governments. It is not possible to include that information in full in a necessarily restricted report of this nature: the summary is therefore confined to selected items that illustrate the fields of medical investigation that are being explored.

Federation of Malaya

157. The Director of the Institute for Medical Research, Kuala Lumpur, Dr. J. W. Field, has furnished a summary of the activities of the Institute during the year. Excerpts from it, pertaining to filariasis and malaria (other than the particular malaria control schemes initiated with the aid of Colonial

Development and Welfare research funds) have been given in their appropriate context earlier in this Report. Other investigations noted by Dr. Field are as follows:—

Bacteriology

158. The search for promising strains and their despatch for further study to England of antibiotic-producing moulds and bacteria from Malayan soil, reported in last year's Annual Report, has continued. The results to date are encouraging; some of the antibiotics produced appear to be highly active against the tubercle bacillus. Studies are in progress on the effect of streptomycin in reducing the bacterial content of anti-smallpox vaccine lymph, and on the pathogenicity of the gas-forming anaerobes which are occasionally contaminants. The role of Malayan animal salmonellas as pathogens in man is being investigated.

Entomology

159. Since the possibility that yellow fever might reach Malaya is an ever-present hazard, and little is known there of the relevant ecological background, preparatory to more comprehensive studies a small-scale survey of the prevalence and distribution of *Aëdes aegypti* in towns and kampongs has been instituted, in conjunction with a study by the Colonial Office Scrub-Typhus Unit of the habits of monkeys on the fringes of Kuala Lumpur. Colonies of *A. aegypti* and *A. albopictus* have also been established. The Senior Entomologists of the Department of Agriculture and of the Institute have studied the fly problem at Cameron Highlands, one of the important Hill Stations where control measures found adequate for the plains have proved inadequate. A joint interim report has been issued. Comparative studies in Kuala Lumpur suggest that ants, scarce in the Highlands, play an important role by destroying maggots and eggs.

Pathology

160. An examination of some 500 human and animal sera, collected from various parts of Malaya, was made during 1951 to ascertain whether "Q" fever, a world-wide rickettsial disease caused by *R. burneti,* is present in Malaya. Complement-fixing antibodies were found in two human sera, and in six sera from cattle and goats. Further tests during 1952 on 400 human sera, mostly from cases with fever of unknown origin, were all negative, so that the disease is unlikely to be a common cause of fever in Malaya.

Biochemistry

161. The investigations of the biochemists have appropriately had a bias towards the nutritional aspects of disease. They have included studies on anaemia, which is an almost invariable sequel of malnutrition, on liver changes of dietary origin, on the effect of Malay and Indian cooking on the calcium, iron and phytic acid content of parboiled rice, and on malnutrition in infants. Attempts to find a suitable applicant for the post of Senior Nutrition Officer having so far been abortive, much of the work of the Division of Nutrition has devolved on the biochemists. Data collected in co-operation with the Department of Fisheries among a fishing community have been analysed, and a joint report is impending. Consultations with various government departments and with the military authorities on important nutritional problems have been frequent.

The United States Army Medical Research Unit (Malaya)

162. The activities of this Unit, directed by Dr. Joseph E. Smadel, which has its headquarters at the Institute for Medical Research, have been recorded

earlier in this Report (para. 96). This Unit, with a nucleus of four American research workers posted for a three-year period, will share with the Colonial Office Scrub-Typhus Research Unit the additional research block that the Government of the Federation of Malaya has provided during the past year; it will materially contribute to its equipping. It is confidently hoped that these extended laboratory facilities will continue increasingly to foster co-operative research at a Commonwealth and international level.

Kenya

163. In the Division of Insect-Borne Diseases of the Kenya Medical Department Dr. R. B. Heisch and his collaborators report that 25 cases of malaria were treated with daraprim, and it was found that one dose of 50 mgs. cleared parasites from the blood in 1 to 3 days. The drug rapidly cured three patients with cerebral malaria. A paludrine resistant strain of *P. falciparum* from Malaya was also found to be daraprim resistant. A single dose (50 to 100 mgs.) of daraprim administered to about 4,000 Africans in a Native Reserve near Nairobi reduced the parasite-rate from 50 to 2 per cent. *Pasteurella pestis* was shown to be firmly entrenched in wild rodents caught near Rongai, about 120 miles north of Nairobi. Cultures were isolated from *Arvicanthis, Mastomys, Otomys,* and *Rhabdomys* sp. This is the first time that wild-rodent plague has been demonstrated in Kenya. It is believed that the wild rodents are the primary reservoir of plague in Kenya and not *Rattus* as was formerly supposed. All the cultures reduced nitrates and acidified glycerine.

164. Several humans suffering from general paralysis were infected with *Spirochaeta dipodilli,* a parasite of gerbils closely related to *S. duttoni.* After an incubation period of 7 to 8 days there was a rise of temperature with scanty spirochaetes in the peripheral blood; several patients relapsed. When testing terramycin against *S. duttoni* in white rats it was found that, even though 100 mgs. per kg. failed to prevent relapses and the development of residual brain infections, very small doses rapidly cleared spirochaetes from the blood. Gamexane dispersable powder (P520), applied to the floors and inner walls of native huts, was found much more effective against *O. moubata* than a 0·5 per cent. gammexane dusting powder.

A new *Ornithodoros* from a *Rhabdomys* burrow in South Africa was described, and named *Ornithodoros zumpti* n.sp. after its collector; *O. erraticus* was discovered in Uganda; and a new species of *Argas,* probably related to *Argas boueti,* was found in Kajiado in the Masai Reserve.

165. Surveys were made to assess the prevalence of fluorosis, as manifested by dental changes in children. Water-analyses for fluorine content were also made. The findings that in certain areas a large proportion of children showed varying degrees of fluorosis were later confirmed by Dr. T. Ockerse, Dental Health Officer of the Health Department of the Union of South Africa, who visited the Colony at the request of the Kenya Government.

Fiji

166. The Medical Department reports that clinical trials of *Sulphetrone, Dapsone, Thiacetazone, Ethizone* (p-ethylsulphonylbenzaldehyde thiosemicarbazone), isonicotinic acid hydrazide (*Isoniazid*) (in form of both *Pycazide* and *Cotinazin*), and of *B.283* (2-anilino-3-amino-5 phenylphenazide hydrochloride) were made at the Leprosy Hospital at Makogai by the Medical Superintendent, Dr. C. J. Austin. About 65 per cent. of all patients have undergone treatment with some sulphone derivative, and of these a little more than half have received *Sulphetrone. Dapsone* has, however, proved

equally as effective, and, in view of its lower cost, is gradually replacing *Sulphetrone* as the "standard" basis of treatment. Although results with Ethizone have been encouraging, it does not appear that this drug is likely to supplant the sulphones, though it may prove to be a useful auxiliary either as part of a combined treatment or as a substitute in cases where patients are unable to tolerate the sulphones. The treatment with *Pycazide* has produced most striking results in advanced cases, two of which had been regarded as moribund.

Clinical trial of *Isoniazid* in tuberculosis has also been made at the Tamavua Tuberculosis Hospital. Although beneficial effects have been observed, it appeared that, used by itself, this drug was no better than Streptomycin and P.A.S. used in combination. *Isoniazid* is now used only as an adjunct to other anti-tuberculosis drugs.

Jamaica

167. In the Faculty of Medicine of the University College of the West Indies much attention is being given to a study of "Vomiting Sickness". Reports record that this malady, sudden in onset and severe in degree, is often fatal, especially in children. They relate that vomiting is a symptom extremely common in Jamaica in a number of diseases, and that malnutrition, especially in those forms which damage the liver, may render much of the population peculiarly susceptible to a variety of toxins, especially in an unhygienic environment. In the *sporadic* form of "Vomiting Sickness", the cause is particularly elusive, since worms, malnutrition and malaria may be causal or concomitant factors of the condition. In the *familial* form, where two or more members of a household are affected, a common factor may narrow down the issue. More conclusive data can be expected from the *epidemic* form, as then clinical, pathological and environmental conditions can receive detailed study.

That the fruit "ackee" (*Blighia sapida*) may contain a toxic principle, and that certain cases of vomiting are associated with its consumption, are accepted as facts by some observers. The immature fruit has been alleged to contain a cyanogenic glucoside. But many people eat unripe, unopened or raw ackees, and drink the water in which they have been cooked, with relish and in large quantity without ill-effect. The value of ackee as a food is considerable, for it contains 16–18 per cent. of fat.

In order to make possible a comprehensive investigation of the problem, the Government of Jamaica has allocated £10,000 for the study. The Faculty of Chemistry is investigating the toxic constituents of the ackee; and has succeeded in isolating and purifying toxic material on which work continues. The Faculty of Pathology and the Government Analyst are collaborating in examination of excreta and other relevant material from the patient. The nutritional and social backgrounds are being assessed.

168. Other investigations by the University staff include the effects of dietary supplements on the blood-chemistry of 400 children, the significance of vitamin B.12 in their diet, and the causation of fatty changes of the liver. A full-time research worker with part-time assistance is studying the epidemiology, therapy and experimental pathology of yaws.

Tanganyika

Sleeping Sickness

169. The Sleeping Sickness Specialist has made clinical trials of Mel.B and pentamidine in the treatment of this disease. Provisionally highly satisfactory results are reported following the administration of Mel.B

in late and relapsed cases of rhodesian sleeping sickness. Of a small group of eight cases treated with Mel.B, hitherto regarded as incurable, seven are reported as being alive and well 12–14 months after treatment. These trials continue, and a final opinion is reserved.

Experiments proceed also on the use of pentamidine in combination with tryparsamide in selected cases of rhodesian sleeping sickness. The results so far reported do not suggest that this method is likely to supersede existing methods of treatment.

170. *Plague.* Although perhaps not strictly a research project, reference is made here to the experimental use of streptomycin in a plague outbreak involving 346 cases and 50 deaths in the Singida district of the Central Province during 1952. Remarkable success was obtained in cases treated within three days of onset, especially bubonic and septicaemic plague without pneumonic involvement. A number of cases of primary pneumonic plague were reported during the outbreak, but there is no record of the results of streptomycin treatment in these cases except that it appears to have been less successful than in the case of the bubonic and septicaemic types. The death-rate varied with the measure of delay in treatment after onset, and also with the type of case. It was usually between 10 and 15 per cent.; but in one isolated outbreak of 50 cases there were 20 deaths, 11 reported to be primary pneumonic plague. In all types, where death occurred it was usually within 12 hours of admission to hospital. The average total dosage of streptomycin was a little under 4 gms. for adults, and a little under 3 gms. for children. The range of dosage varied from 1 gm. (in children) to a maximum of 6 gms. Of the first 100 cases treated, 43 were discharged from hospital within five days and 31 more within 10 days.

An interesting feature of the response of bubonic plague was that, despite the dramatic improvement in clinical condition, i.e. temperature, tachycardia, malaise, there was no corresponding reduction in the size or tenderness of the bubo, irrespective of the duration of streptomycin treatment. Many of the larger bubos became in fact septic. Therefore surgical removal of the bubo was undertaken as soon as the general symptoms had subsided, with uniformly successful results. Later, the bubos were excised in four newly-admitted cases while under treatment; in two the temperature became normal within a few hours of removal and complete cure resulted following only 1 gm. of streptomycin.

Committee for Colonial Agricultural, Animal Health and Forestry Research Eighth Annual Report (1952-1953)

Ministry of Food,
Dean Bradley House,
Horseferry Road,
London, S.W.1.
7th July, 1953.

SIR,

I have the honour, on behalf of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to transmit to you the Eighth Annual Report of the Committee covering the period 1st April, 1952, to 31st March, 1953.

I have the honour to be,
Sir,
Your most obedient servant,
(Sgd.) NORMAN C. WRIGHT.
(*Chairman*).

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

Membership

DR. NORMAN C. WRIGHT, M.A., D.Sc., Ph.D., F.R.I.C., Chief Scientific Adviser to the Ministry of Food (*Chairman*).

SIR EDWARD SALISBURY, C.B.E., D.Sc., V.P.R.S., Director, Royal Botanic Gardens, Kew (*Vice-Chairman*).

MR. F. C. BAWDEN, M.A., F.R.S., Head of Plant Pathology Department, Rothamsted Experimental Station.

DR. G. D. H. BELL, Ph.D., Director, Plant Breeding Institute, Cambridge.

PROFESSOR W. I. B. BEVERIDGE, M.A., D.V.Sc., Professor of Animal Pathology, Cambridge University.

DR. J. CARMICHAEL, C.M.G., D.Sc., M.R.C.V.S., Dip.Bact., Veterinary Research Division, May and Baker, Limited.

PROFESSOR H. G. CHAMPION, C.I.E., D.Sc., Professor of Forestry, Oxford University.

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Adviser to the Secretary of State on Agriculture.

MR. F. S. COLLIER, C.B.E., Adviser to the Secretary of State on Forestry.

DR. E. M. CROWTHER, D.Sc., F.R.I.C., Head of Chemistry Department, Rothamsted Experimental Station.

SIR FRANK ENGLEDOW, C.M.G., M.A., B.Sc., F.R.S., Drapers' Professor of Agriculture, Cambridge University.

DR. W. J. HALL, C.M.G., M.C., D.Sc., Director, Commonwealth Institute of Entomology.

MR. G. V. B. HERFORD, O.B.E., M.Sc., Director, Pest Infestation Laboratory, Department of Scientific and Industrial Research, Slough.

PROFESSOR J. W. MUNRO, C.B.E., M.A., D.Sc., Professor of Zoology and Applied Entomology in the University of London.

SIR RAYMOND PRIESTLEY, M.C., M.A., D.Sc., LL.D.

MR. R. J. SIMMONS, C.B.E., M.R.C.V.S., Adviser to the Secretary of State on Animal Health.

SIR WILLIAM SLATER, K.B.E., D.Sc., F.R.I.C., Secretary, Agricultural Research Council.

DR. S. P. WILTSHIRE, M.A., D.Sc., Director, Commonwealth Mycological Institute.

DR. G. A. C. HERKLOTS (*Secretary*).

MR. K. D. LAW (*Assistant Secretary*).

Terms of Reference

The terms of reference of the Committee are as follows:

(*a*) To determine, in consultation as necessary with the Colonial Advisory Council of Agriculture, Animal Health and Forestry, the matters in these fields of science in which research is required to be carried out in or for the Colonial Empire, to assess their relative importance and urgency and to advise on the general policy for such research.

(*b*) To advise on the actual provision required for such research in or for the Colonial Empire, whether in Colonial territories themselves or elsewhere, and on the scope and functions of regional and other research institutions in the Colonial Empire.

(*c*) To keep under review, and comment upon, the course of research in these fields.

(*d*) To keep under review the arrangements for the publication and dissemination of technical and scientific information required for, or arising in the course of, research in these fields, and to make such recommendations as may be appropriate from time to time.

(*e*) To advise, in consultation with the Advisory Council, on the best means of making available the results of research for the development and improvement of agriculture, animal health and forestry in the Colonial Empire.

(*f*) To advise on the recruitment, training and terms of employment of the Government scientific personnel required for agricultural, animal health and forestry research in or for the Colonial Empire in collaboration, so far as may be desirable and necessary, with the advisory Council and the Colonial Service Department of the Colonial Office.

The work of the Committee is assisted by three sub-committees whose membership is as follows:

COCOA RESEARCH SUB-COMMITTEE

MR. W. B. L. MONSON, C.M.G. (*Chairman*).

DR. F. H. BANFIELD, M.Sc., Ph.D., F.R.I.C., British Food Manufacturing Industries Research Association.

DR. E. C. BATE-SMITH, M.Sc., Ph.D., Low Temperature Research Station, Department of Scientific and Industrial Research.

MR. F. C. BAWDEN, M.A., F.R.S., Rothamsted Experimental Station.

DR. E. E. CHEESMAN, D.Sc., A.R.C.S., Agricultural Research Council.

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Adviser to the Secretary of State on Agriculture.

MR. F. S. COLLIER, C.B.E., Adviser to the Secretary of State on Forestry.

SIR FRANK ENGLEDOW, C.M.G., M.A., B.Sc., F.R.S., Drapers' Professor of Agriculture, Cambridge University.

SIR GEOFFREY EVANS, C.I.E., M.A., Royal Botanic Gardens, Kew.

DR. W. J. HALL, C.M.G., M.C., D.Sc., Director, Commonwealth Institute of Entomology.

DR. G. A. C. HERKLOTS, M.Sc., Ph.D., F.L.S., Secretary for Colonial Agricultural Research.

PROFESSOR J. W. MUNRO, C.B.E., M.A., D.Sc., Professor of Zoology and Applied Entomology in the University of London.

DR. A. F. POSNETTE, M.A., Ph.D., A.I.C.T.A., East Malling Research Station.

MR. R. V. WADSWORTH, Cadbury Brothers, Limited.

MR. E. E. WELLS, Rowntree and Company, Limited.

DR. S. P. WILTSHIRE, M.A., D.Sc., Director, Commonwealth Mycological Institute.

MR. K. D. LAW (*Secretary*).

SOILS SUB-COMMITTEE

DR. E. M. CROWTHER, D.Sc., F.R.I.C., Head of Chemistry Department, Rothamsted Experimental Station (*Chairman*).

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Adviser to the Secretary of State on Agriculture.

DR. W. DAVIES, D.Sc., Grassland Improvement Station, Ministry of Agriculture and Fisheries.

DR. F. DIXEY, C.M.G., O.B.E., D.Sc., F.G.S., M.I.M.M., Director of Colonial Geological Surveys.

DR. H. GREENE, D.Sc., Adviser on Tropical Soils, Rothamsted Experimental Station.

DR. G. A. C. HERKLOTS, M.Sc., Ph.D., F.L.S., Secretary for Colonial Agricultural Research.

MR. G. V. JACKS, M.A., B.Sc., Director, Commonwealth Bureau of Soil Science.

DR. A. MUIR, B.Sc., Ph.D., Rothamsted Experimental Station.

DR. E. W. RUSSELL, M.A., Ph.D., Department of Agriculture, Oxford University.

DR. A. B. STEWART, M.A., B.Sc., Ph.D., F.R.I.C., Macaulay Institute for Soil Research.

SIR HAROLD TEMPANY, C.M.G., C.B.E., D.Sc., F.R.I.C.

DR. F. YATES, Sc.D., F.R.S., Rothamsted Experimental Station.

MR. K. D. LAW (*Secretary*).

STORED PRODUCTS RESEARCH SUB-COMMITTEE

MR. G. V. B. HERFORD, O.B.E., M.Sc., Director, Pest Infestation Laboratory, Department of Scientific and Industrial Research (*Chairman*).

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Adviser to the Secretary of State on Agriculture.

DR. J. W. EVANS, M.A., D.Sc., Infestation Control Division, Ministry of Agriculture and Fisheries.

MR. J. C. GLOVER, Oils and Fats Division, Ministry of Food.

MR. F. W. IRVING, Messrs. J. A. Irving and Company, Limited.

DR. G. A. C. HERKLOTS, M.Sc., Ph.D., F.L.S., Secretary for Colonial Agricultural Research.

DR. W. F. JEPSON, O.B.E., Ph.D., A.R.C.S., Imperial College of Science and Technology.

MR. L. W. PHILLIPS, C.B.E., Chairman, National Federation of Corn Trade Associations.

MR. C. W. RUSTON.

MR. J. J. S. SCOULER, C.B.E., Dried Fruits and Edible Nuts Division, Ministry of Food.

DR. T. H. C. TAYLOR, D.Sc., Commonwealth Institute of Entomology.

MR. J. WOODFORDE, A.M.I.Mech.E., A.M.I.E.E., A.C.G.I., National Institute of Agricultural Engineering.

MR. K. D. LAW (*Secretary*).

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

EIGHTH ANNUAL REPORT

CONTENTS

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

EIGHTH ANNUAL REPORT

I. GENERAL

In the course of the year the Committee held four meetings. The activities of the Standing Sub-Committees, covering research on cocoa, stored products, and soils, are recorded in their separate reports which appear in Section VI.

2. The Committee desire to record their appreciation of the valuable advice which has been made available to them by the members of the Sub-Committees and by the various informal consultative panels, which include specialists in a number of fields who are not members of the Committee.

3. Visits to Colonial territories have continued to play an important part in the affairs of the Committee. A delegation, comprising Sir William Slater, Sir Frank Engledow, Professor Beveridge and Dr. Crowther, visited the regional research organisations in East Africa. Sir William Slater and Professor Beveridge attended the Fourth Meeting of the East African Advisory Council of Agriculture, Animal Industry and Forestry, and Dr. Crowther a Technical Conference on Fertilizers at the East African Agriculture and Forestry Research Organisation. Sir Frank Engledow and Dr. Crowther also visited cotton and other research stations in the Sudan and East Africa at the invitation of the Sudan Government and the Empire Cotton Growing Corporation. Mr. Collier went to the West Indies and Cyprus and attended the British Commonwealth Forestry Conference in Canada. Mr. Simmons visited the Gold Coast, Nigeria, and the East African territories.

4. Despite the serious depletion of the funds set aside for agriculture, animal health and forestry research under the Colonial Development and Welfare Acts, it has been possible to finance, in part or in whole, a number of important new projects and, by supplementary grants, to give continued assistance to existing schemes. Grants totalling £372,286 were made during the year.

5. Technical assistance to Colonial Governments has continued to be given, on a somewhat limited scale owing to recruitment difficulties, by the Mutual Security Agency. The search continues for suitably qualified American scientists to undertake a number of outstanding projects recommended by the United States missions which visited Colonial territories.

II. LIAISON WITH RESEARCH INSTITUTIONS

6. It is desired to acknowledge gratefully the invaluable assistance which has been rendered to the Colonial Office and Colonial territories by the various institutions concerned with agricultural research in the United Kingdom and other parts of the Commonwealth. Unfortunately limitations of space do not permit reference to the work of more than a few of these institutions which is described briefly below.

Commonwealth Institute of Entomology

7. The 1952 volume of the Bulletin of Entomological Research which is published by the Institute, contained twenty articles by entomologists working in the Colonies in addition to many others of interest to Colonial entomologists.

8. The Institute's information service, apart from its publications, was again utilised by almost all the Colonial territories and embraced a wide range of subjects. One item that required the devotion of a considerable amount of time and research was the checking of a long list of insects from Nigeria. Mr. W. V. Harris, Officer-in-Charge of the Colonial Termite Research Scheme, is now attached to the Institute and apart from identifying termite material sent in for determination, deals with enquiries for information in this field (see para. 82).

9. It has been arranged that the Institute shall act as the channel through which the Colonies shall send their information for the World Reporting Service of the Food and Agriculture Organisation. Immediate reports of new outbreaks, one of *Oryctes rhinoceros* in Fiji and the other of the onion fly, *Dizygomyza cepae* from Singapore Island and Johore, have already been transmitted and reports setting out the more important developments in the insect pest position will be sifted and combined into half yearly reports for transmission to Rome.

10. The identification service of the Institute was used by sixteen Colonial territories during the year. The number of specimens received from them for identification was 21,955, or about 35 per cent. of the total received from all sources ; they were sent in by fifty-six entomologists and others concerned with applied entomology. Many of the species in these consignments were represented by numerous specimens ; nevertheless the number of identifications sent out to the Colonies was no fewer than 3,700, or about 45 per cent of all the identifications done by the Institute during the year.

Commonwealth Mycological Institute

11. A major function of the Institute is the abstracting of the world's literature on the diseases of plants in their Review of Applied Mycology, a vital service for Colonial plant pathologists. A considerable increase in the literature has been a marked feature of the past year.

12. Of the new records of plant diseases identified at the Institute during the year may be mentioned the occurrence of red rot of sugar-cane (*Physalospora tucumanensis*) in Nigeria. The perfect state of this major fungus pathogen was first recorded from West Africa by Mr. Hughes, lately of this Institute, from material collected by him on a visit to the Gold Coast in 1950.

13. Maize rust (*Puccinia polysora*) has continued to spread throughout Africa, as was to be expected, and has now been recorded from most of the African dependencies as well as French West Africa, Southern Rhodesia, and Mauritius. The perfect stage of the rust has now been reported from Nigeria and Kenya so that the identity of the rust is now beyond dispute.

14. The clove die-back fungus has now been named by Nutman and Roberts *Cryptosporella eugeniae*. Other interesting specimens received at the Institute for identification were *Neovossia horrida* and *Nigrospora oryzae* on rice from Sierra Leone, Coffee rust (*Hemileia vastatrix*), *Phyllosticta musarum, and Scolecotrichum musae* on *Musa* from Malaya, and *Colletotrichum tabaci* causing damage to tobacco and *Cercospora carthami* on safflower in Northern Rhodesia.

Commonwealth Institute of Biological Control

15. During the financial year 1952–53 work for the British Colonial Empire has been mainly carried on by the officers of the Californian and West Indian stations, though some projects have been handled from headquarters.

16. At the beginning of September the Director of the Institute flew to Bermuda where he spent about a week studying the Bermuda cedar infestation and discussing the possibility of biological control work on several insect pests. Plans for work on insects attacking the weed *Acanthospermum hispidum* were discussed on this occasion with Dr. J. M. Waterston, Acting Director of Research for Nigeria, who was visiting the Island at the time. Toward the end of the summer the Director began a survey of the parasite fauna of Trinidad using material collected by the temporary assistants of Dr. F. J. Simmonds. After a preliminary study some of this material was taken to Washington for comparison with the named specimens in the collection of the United States National Museum. About 150 species of Dipterous parasites have been found in the material sent up by Dr. Simmonds and of these about three-quarters have been determined.

17. Work in Bermuda has been carried on by a temporary assistant appointed on the advice of the Institute and working under Institute direction. During the winter season this assistant, Mr. Alan Dustan, made a careful study in order to determine the difference between trees which are resistant and trees which are susceptible to attack by the Bermuda cedar scale. Nothing very definite has yet emerged from this study, but at least a number of possibilities have been eliminated. Material was collected for a survey of the parasites of the cedar scale which will be carried out by the Director in the summer of 1953. In the Californian laboratory Mr. W. F. Sellers and Dr. D. C. Lloyd continued work on the biology of the predators of the cedar scale and mealybug parasites. Eighty-three shipments of parasite material comprising over 77,000 specimens were shipped to Bermuda.

18. During the same period 331 consignments of mealybug parasites comprising about 195,000 individual specimens were despatched to the Gold Coast for the control of the mealybugs which carry the swollen shoot disease of cocoa.

19. Early in February Dr. Lloyd left California for Trinidad where he discussed mealybug parasite rearing work with Dr. Simmonds and his assistants and then proceeded to South America to make a survey of mealybug parasites for the Gold Coast and of insects that might be of use in the control of the weed *Acanthospermum hispidum* in Nigeria. At the end of the financial year Dr. Lloyd was still engaged in this survey in which he covered a number of South American countries.

20. At the beginning of 1953 Dr. F. J. Simmonds left Trinidad for a tour in East Africa, the Seychelles and Mauritius. The main object of this trip was the investigation of a coconut pest (*Melittomma*) in the Seychelles. This investigation was carried out in co-operation with entomologists sent out by the Commonwealth Institute of Entomology. The object of Dr. Simmonds' visit was to decide on the possibility of biological control of *Melittomma*. However, at the request of the Government of Mauritius he visited the Colony to study the results of insect introductions carried out by the Institute in co-operation with the entomologists of Mauritius for the control of the weed *Cordia macrostachya*. Dr. Simmonds found that while patches of the weed still exist here and there in the Island the bulk of the infested areas have cleared, so the experiment may be ranked as one of the most successful in the history of the biological control of noxious plants. When in East Africa Dr. Simmonds consulted with the local entomologists on problems of mutual interest. Mr. F. D. Bennett, the assistant of Dr. Simmonds, visited Grenada, the Leeward Islands and Toboga during the financial year in connection with various problems. A preliminary investigation of the possibility of biological control of *Lantana* and other weed pests

of Fiji has been carried out. Studies of the natural enemies of certain pests of the pigeon-pea and of the small moth borers of sugar-cane have been made on behalf of the Government of Mauritius.

21. During the course of the financial year a total of 184 shipments have been sent to various colonies and to Australia, and these comprised 154,000 parasites and predators attacking various insect pests.

22. Finally a memorandum on the possibilities of the biological control of cotton pests in the West Indies was prepared by Dr. Simmonds on behalf of the British West Indies Sea Island Cotton Growers Association.

III. REGIONAL RESEARCH

(*a*) *EAST AFRICA*

The East African Agriculture and Forestry Research Organisation

23. 1952 has seen a full year's work at the new headquarters at Muguga, where the research staff now numbers 25, including the Director, Sir Bernard Keen, F.R.S. The declaration of a State of Emergency in Kenya during the latter part of 1952, when almost the whole of the staff undertook police and other special duties, slowed progress in some sections.

24. The Organisation continued to provide facilities for workers from outside its own staff. A Termite Research Unit and a centre for training ecologists are established at Muguga ; laboratory space was provided for Professor Stelly of the University of Georgia, working under M.S.A. auspices on a collaborative soil fertility project with the Kenya Department of Agriculture. Mr. Eastop, a Colonial Research Fellow, began his study of the taxonomy and biology of aphids. A year's visit was made by Dr. Hursh, Chief of the Division of Watershed Management and Forest Influences in the U.S. Forest Service, under the Fulbright Act. Dr. Hursh spent the greater part of 1952 in East Africa, carrying out field studies on the relation between forest management and local climate and soil and water resources.

25. The work of the forest entomologist included a survey, in close collaboration with officers of Forestry Departments, of East African insects damaging trees and timber: a cerambycid woodborer of living conifers, as well as of their timber, constitutes a serious threat to the softwood industry in Kenya ; and research suggests that changes in silvicultural methods may be necessary.

26. Research in soil microbiology started with the short-term secondment of Dr. Jane Meiklejohn from Rothamsted Experimental Station. Her work has been mainly survey and the assessment of problems ; but in collaboration with the Uganda Department of Agriculture she is attempting to relate observed changes in the nitrate content of certain Uganda soils with the soil flora.

27. With help from the Kenya Department of Agriculture, studies were begun on methods for establishing stable heterozygous maize populations suitable for African growers. Work on cassava breeding continued at Amani: there was increased appreciation of the value of Amani cassava hybrids in areas where virus diseases are prevalent ; and trials were made at many departmental stations in East Africa.

28. In view of the threat to maize production resulting from the appearance of the American rust disease, caused by *Puccinia polysora* Underw., the Plant Pathology Division, under Dr. H. H. Storey, F.R.S., undertook a

project of testing maize varieties for resistance to this fungus by intensive glasshouse methods. By the end of the year a satisfactory technique for inoculation was taking shape. The project is essentially a co-operative one, with the plant pathologist of the Kenya Department assisting in the mycological work, and the Kenya and Uganda Departments, as well as the E.A.A.F.RO. workers at Amani, taking part in the field testing. Contact is being maintained by correspondence with West African workers on this problem.

29. Dr. Sheffield continued her work on virus diseases of sweet potatoes and made progress in sorting out the several viruses responsible for the wide range of symptoms observed in the field.

30. The plant physiologist, Mr. Glover, has shown that chilling is necessary to stimulate the growth of pyrethrum buds and the main harvest follows the earlier cold season. Early pruning does not alter the yield or time of harvest and late pruning can cause loss in yield. The number of diseased buds also is related to the climate ruling some weeks earlier. Variations in growth and productiveness of individual plants belonging to a single clone appear to be due to differences in the quality of the material used for planting; this suggests that an important practical advance may be possible by improving horticultural methods. A spraying experiment has shown that Bordeaux Mixture applied in massive—though probably uneconomic—doses can give practical freedom from diseased buds at Muguga.

31. The most important outcome of Mr. McKinlay's co-operative work with the entomologists of the Cotton Research Station, Namulonge, was the demonstration of the repellant effect of certain insecticides against the *Lygus* pest. It thus becomes possible to design certain types of experiment on *Lygus* damage which avoid the difficulties of reinfestation by this mobile insect. D.D.T. appears to be the most effective insecticide against bollworms.

32. For forestry research the year was largely one of consolidation and the development of experiments at Muguga. Important improvements in nursery technique were made and were demonstrated at a course attended by officers from all the territorial Departments. The Forest Bureau is well established and receives many demands for information.

33. Soil surveys at different category-levels were continued by Mr. Gethin Jones. These included the mapping on a scale of 1 :50,000, aided whenever possible by aerial photographs, of ten soil associations over an area of about 200 square miles between Nairobi and Thika; and, in less detail, a further 250 square miles of adjoining higher land in the Kikuyu Reserve; also, large scale detailed soil surveys, based on frequent soil augering, of the Muguga region and of the Coffee Research Station near Ruiru.

34. Other wide-spread reconnaissance soil surveys were made in co-operation with territorial Agricultural Officers, mainly in the Kenya Highlands. The main kinds of soil occurring in different regions were classified and defined, thus giving field officers a more scientific basis for land-use surveys.

35. The laboratory work on the fertility of tropical soils was continued by Dr. Birch, mainly on relating phosphate response to soil characters measurable in the laboratory. In acid soils, phosphate response is inversely related to percentage saturation of the base-exchange capacity, as previously reported; and this relation is now extended to soil pH and to the amount of soil silica extractable by water (or by 1 per cent. citric acid). A tentative equation was derived to estimate the amount of available phosphate in a

soil, given determinations of its acid-soluble phosphate and of the percentage saturation of its base-exchange capacity. Work has now been extended to analyses of plants grown on the soils on which known responses have been obtained.

36. The newly-formed joint Animal Industry Division was still in the early development phase, but good progress was made in preparing the farm lands and buildings, in establishing grass and fodder-crop plots and in initial stocking with poultry, sheep and pigs.

37. The East African Herbarium, now established as a section of E.A.A.F.R.O. in Nairobi at the Corydon Museum, besides continuing routine work on behalf of other scientific workers and the general public, prepared for publication a number of original contributions on plant taxonomy.

38. In accordance with arrangements concluded with the Overseas Food Corporation, three of its research officers work under general scientific supervision of E.A.A.F.R.O. Important results were obtained from field studies at Nachingwea on groundnut rosette and its vector, *Aphis craccivora*. Accumulated evidence still points to the volunteer groundnut plant as the agent that carries both virus and vector from one crop to the next; varieties whose seed lies dormant in the ground are thus less dangerous than those that can germinate immediately after harvest. Systemic insecticides, applied to the seed at planting, are under trial in the expectation that they will reduce the aphid-population within the field and so reduce the spread of the virus. The main natural agency controlling the aphis is several predators, and means for increasing their numbers are being studied.

39. Studies at Kongwa bearing on dry-farming methods were concentrated on measurements of water stored under land differently treated. With twenty-two inches of well-distributed rain, bare fallow conserved about seven inches of available water in the first six feet of soil; whereas volunteer weeds and grasses, and a heavy crop of maize, both reduced the soil profile to the wilting range. A detailed soil survey of a considerable part of the Nachingwea area was completed.

40. Scientific papers in 1952 by the staff of E.A.A.F.R.O. and related schemes included:

H. F. BIRCH, The Relationship between Phosphate Response and Base Saturation in Acid Soils, J. Agric. Sci., 1952, 42, 276–285.

M. H. FRENCH, Mineral Deficiencies in Farm Livestock, E. African Agric. J., 1952, 18, 4–8.

J. GLOVER, Calculations of the Wetness of Air, E. African Agric. J., 1952, 17, 162–165.

P. J. GREENAWAY and B. VERDCOURT, Notes from B. A. Herbarium, Kew Bull., 1952, 1952, 353–365.

A. L. GRIFFITH, East African Enumerations, *Pterocarpus angolensis* in mixed woodland, Emp. For. Rev., 1952, 31, 146–149; Watershed Management in the U.S.A., Emp. For. Rev. 1952, 31, 103–114.

K. S. MCKINLAY, Phytotoxicity of BHC to Cotton, Emp. Cotton Growing Rev., 1952, 29, 269–272.

H. C. PEREIRA, Interception of Rainfall by Cypress Plantations, E. African Agric. J., 1952, 18, 73–76.

F. M. L. SHEFFIELD, Studies of the Clove Tree, IV, Natural Grafting and its bearing on Sudden-Death Disease, Ann. Appl. Biol., 1952, 39, 103–110.

B. VERDCOURT, The Identity of *Ophiorrhiza lanceolata* Frosk., Kew Bull., 1952, 1951, 377–380 ; Revision of Certain African genera of herbaceous Rubiaceae, I, The genus *Pentanisia* Harv., Bull. Jard. Bot. Brux., 1952, 22, 233–286 ; Two new species of *Pentanisia* from Kenya Colony, Kew Bull., 1952, 1951, 381–385 ; Notes on Tropical African dodders, E. African Agric. J., 1952, 18, 85–86.

M. J. WAY, An Insect Pest of Coconuts and its Relationship to Certain Ant Species, Nature, Lond. 1951, 168, 302.

The East African Veterinary Research Organisation

41. By the end of the year the major buildings and other facilities of the new headquarters at Muguga South were either completed or well advanced. The external structure of the main laboratory is now finished and the installation of services, including facilities for visiting research workers, is well under way. Most of the isolation buildings and a number of stores and houses for small animals are completed. At Muguga North, where research into animal diseases and the manufacture of biological products is to be carried out, the road system and water supplies are completed and about half the area of 1,000 acres of rough grassland, bush and wattle plantation has been cleared and divided into paddocks by permanent fencing ; substantial progress has been made in the development of pastures. A rapid expansion of the colonies of standardised small experimental animals will be made possible by the large numbers of breeding females which have been reared during the past year.

42. Dr. S. F. Barnett continued his research on the pathology and pathogenesis of East Coast fever, under the guidance of Professor W. H. Taliaferro of the University of Chicago, as holder of a Commonwealth Fund Fellowship, and towards the end of the year at Kabete. These studies were made on the tissues of susceptible grade cattle slaughtered at different stages of the disease. Special attention was paid to the lymphoid, myeloid and reticuloendothelial tissues, as they are the tissues principally involved and little was known about them.

43. The collection of data on the incidence and significance of East Coast fever in Zebu calves born in the enzootic area of Nyanza Province was continued during 1952, and all calves born within two small districts about 70 miles apart have now been under observation for three years.

44. From the findings it is concluded that East Coast fever in natural infections of Zebu cattle is not the highly fatal disease experienced in grade stock. The reasons for the resistance of the Zebu stock are now being investigated experimentally.

45. Mr. R. N. Fiennes' researches confirmed earlier findings that treatment of bovine trypanosomiasis with antrycide appears to be effective in the early stages of disease but is much less so in advanced trypanosomiasis, and that prophylactic treatment of cattle in contact with tsetse fly should be given at least once every two months. Summarizing several years' experience of antrycide, Mr. Fiennes was of the opinion that the main factor that appears to determine the success of the drug in protecting cattle is the severity of the challenge by trypanosomes, which in turn depends on the species and the number of tsetse flies to which the cattle are exposed. The work on drug resistance to antrycide was continued. Preliminary experiments were carried out with a drug, No. 528, supplied by Dr. F. Hawking of the Medical Research Council, which suggest that this drug is not superior to antrycide. Mr. Fiennes also continued his studies of the anaemia in

trypanosomiasis and made some interesting observations on the variations occurring in the blood of normal cattle.

46. After several years of work on the difficult and most important problem of the development of a serological test for the rinderpest viruses, Mr. J. G. Brotherston is now obtaining promising results.

47. Dr. J. A. Dinnik continued research on the systematics and life-cycles of the paramphistomes of domestic ruminants, important parasites of livestock in Africa about which relatively little is known. Seven species have now been found, and their morphology is being studied with particular reference to variation within the species, in order to find reliable features for identification. The intermediate snail hosts have been determined and the life-cycle worked out for two more paramphistomes, *Carmyerius exoporus* and *Nilocotyle* sp ; this increases to four the number of life-cycles successfully investigated by Dr. Dinnik. *Bulinus syngenes* has been found to be an intermediate snail host of *Bilharzia bovis* in Kenya. Cattle and snails infected with bilharzia have been found at an altitude of 7,700 feet. The studies of the bionomics of *Haemonchus contortus* larvae on pasture were continued, and while on leave in Australia early in 1953 Dr. and Mrs. Dinnik were able to discuss this and other work at the laboratories of the Council for Scientific and Industrial Research Organisation.

48. The studies on animal nutrition, carried out for three years by Mr. J. R. Todd, were terminated by the resignation of this officer early in the year. Early in 1953, Dr. A. Rogerson was appointed as Animal Nutrition Chemist and will continue these researches in the Joint Animal Industry Division.

(b) WEST AFRICA

49. Mr. D. Rhind, Secretary for Agriculture and Forestry Research, paid visits to a number of research stations and by informal discussions endeavoured to assist collaboration between research officers. In the course of these travels, amongst other matters, the serious damage frequently caused to the sorghum crop by grain midge (*Contarinia sorghicola* Coq.) became apparent. The insect is now believed to cause serious losses of grain in The Gambia, Gold Coast and Nigeria. Losses of 30 per cent. of the grain are common and more severe losses by no means rare. It was also observed that grain smut disease (*Spacelotheca sorghi*) was widespread.

West African Cacao Research Institute

50. The demonstration of the successful control of swollen shoot on some sixty acres of cacao in the Old Station at Tafo by regular inspection, cutting out of symptom bearing trees and replanting was continued. The first infected tree was discovered early in 1939, cutting out was began in 1940, and replanting was commenced in 1945. Fewer than 10 per cent. of the original tree population have so far been lost, although the Station is now within the area of " mass infection ", and the average yield has been maintained at about 600 lb. dry cacao per acre.

51. Investigations were continued on the symptoms and classification of cacao virus strains from the Gold Coast, Nigeria and the Ivory Coast, and on the mealybug vectors of these strains. Work on the control of the mealybug vectors by systemic insecticides and by the introduction of parasites was continued. In controlling the mealybug vectors the main problem to be faced was the smallness of their number ; at Tafo the average number of mealybugs per cacao tree was less than 100.

52. In the Western Province of the Gold Coast it was established that the small indigenous tree *Cola chlamydantha* was commonly infected with cacao viruses which could be transmitted readily to cacao by mealybugs. Elsewhere in the Gold Coast and in Nigeria, where *C. chlamydantha* does not occur, the problem of the alternative hosts of cacao viruses is obscure. Certain indigenous species of forest trees can be infected with cacao virus, but it seems almost impossible subsequently to infect cacao plants from them except in certain conditions of growth which are not yet understood.

53. Among insect pests the capsid bugs provided a problem comparable in magnitude to that of swollen shoot. These bugs in the course of their feeding kill the green shoots and enable infection by the fungus *Calonectria rigidiuscula,* which can cause extensive die-back. The problem was further complicated by the small numbers of capsid bugs involved. On young cacao a satisfactory phophylactic treatment has been worked out, involving the application of a solution containing D.D.T. to those parts of the plant where the capsid bugs rest during the day. Attempts were made to find a satisfactory and economical method of controlling capsid bugs on larger cacao plants.

West African Rice Research Station, Rokupr, Sierra Leone

54. Good progress was made with construction of the laboratories and other buildings at the West African Rice Research Station at Rokupr in Sierra Leone. It is expected that the main laboratory will be completed with gas, water and electricity services before the end of 1953. One botanist and one soils chemist have been recruited. The collection of rice varieties was enlarged by the accession of many new introductions, particularly from the Far East. Attention was also given to the ecology of *Rhizophora* mangroves, particularly since the recent recognition that three species having distinct environmental preferences exist in West Africa.

Maize Rust Research

55. The search for maize varieties which will give a high yield while withstanding attack from the rust disease pathogen, *Puccinia polysora,* continues. No maize so far encountered in Nigerian farms shows any resistance to this rust which has caused heavy loss since 1950. Introductions of maize were accordingly made by the Central Research Organisation of the Department of Agriculture from several different countries in the hope of finding a factor for resistance amongst them. Several promising varieties were selected from a collection of varieties received from the Rockefeller Foundation in Mexico and these are now being further studied.

56. The Colonial Development and Welfare Research Scheme for research into the control of the rust disease got under way towards the latter part of 1952 with the arrival of two members of the team of three specialists; laboratory accommodation and headquarters for the team were provided at Moor Plantation, Ibadan.

West African Institute for Oil Palm Research

57. At the Main Station in Nigeria about 120 acres of palms were planted during the early rains, bringing the total planted area at this station up to just over 960 acres, about two-thirds of which is now in bearing. Planting continues to be very successful, and provided that all the necessary precautions are taken losses do not exceed 1 per cent. Part of the area planted in 1952 was laid out according to the "twin-row" method which is now receiving considerable attention as a practical plantation method.

58. In the Agronomy Division the special research directed towards a further improvement in germination methods was carried a stage further, attention being concentrated on a critical evaluation of the temperature factor and on seed storage conditions. Extensive fertilizer experiments were continued but most of them are as yet in their infancy: in one experiment on a mature plantation at Umuahia, Nigeria, promising results were obtained from the application of potash.

59. In the field of plant breeding a new programme was started which aims at concentrating at the Main Station the progeny of carefully selected palms in a natural grove at Ufuma, and in a small plantation at Aba, both in Nigeria. Over one million seed produced by the controlled pollination of carefully selected high-yielding trees was distributed, and this should provide sufficient material in due course for establishing over 6,000 acres of plantation. The most important of the progeny trials planted in 1952 was a yield comparison of 49 *dura* x *pisifera* crosses laid down in the form of a 7 x 7 lattice square trial. Crosses of this type are of very considerable practical interest as they are expected to give exclusively *tenera* progeny (i.e., palms with thin-shelled fruit and therefore of high oil content).

60. The Pathology Division concentrated on two main problems: nursery diseases, and those nutritional diseases of mature palms which are characterised by various yellow and orange discolorations of the leaves. The nutritional diseases present a very complex picture, but a valuable contribution to their study has been made by Mr. R. A. Bull, Plant Pathologist, who constructed a working classification based on careful observation of symptoms and on histological studies. This should lead to further progress in the investigation of these very important diseases which are always likely to be encountered in palm plantations.

University College of the Gold Coast

61. The Agricultural Department of the University College of the Gold Coast continued the development of its 1,000 acre experimental station on the Accra Plains. Part of the land was used to study the problems of irrigating the plains, which would be made possible by the projected Volta Dam. Research projects begun include irrigation trials on various crops and fodders, and propagation methods on tree crops, pasture management and fodder storage; a study of the Helminth burden in Gold Coast sheep; machinery modification and research in conjunction with the National Institute of Agricultural Engineering and selected machinery manufacturers; a study of processes of soil formation in the tropics, and the distribution and forms of phosphorus in West African soils.

P. H. NYE, A Survey of the Value of Fertilizers to the Food Farming Areas of the Gold Coast, (in three parts), accepted for publication by the Emp. J. Expt. Agric.

Flora of West Tropical Africa

62. The revision of the Flora of West Tropical Africa was continued by Mr. R. W. J. Keay at the Royal Botanic Gardens, Kew. The revised Volume I Part 1 is now ready for the Press. Three preliminary papers were published in the Kew Bulletin, describing new species and genera which will be included in the Flora. Of special importance is the paper on *Rhizophora* which shows that three species of the genus occur in the mangrove swamps of West Africa—the same three as occur on the Atlantic shores of tropical America.

(c) *WEST INDIES*

British West Indies Central Sugar-Cane Breeding Station, Barbados

Cytogenetics of Sugar Cane

63. Further progress was made in the pure-line breeding programme, in which second and third generation selfs and back-crosses were raised in various lines from foundation material of the most successful commercial varieties. As was expected, non-flowering, male-sterility and self-sterility were encountered in some lines, but sufficient seedlings were available to allow of selection within a large number of lines. There were indications that juice quality is generally well maintained on selfing and sib-crossing.

64. A satisfactory cytological technique, involving pre-treatment of root-tips in α-bromonaphthaline solution to condense and spread metaphase chromosomes, was evolved, and the chromosome numbers of the major Barbados varieties in commercial cultivation in the Caribbean area were established. These varied from 100 in B.34104 to 123 in B.41211. B.37172 was shown from its chromosome number to be a self of P.O.J. 2878, and not from a cross, as had been previously thought. In following cytologically the progress towards homozygosity in selfed lines from aneuploid foundation varieties, it was shown that in the early stages, chromosome numbers of selfs may vary to some extent from the parents.

G. C. STEVENSON, The Barbados Sugar-Cane Varieties, Bull. British W. Indies Central Sugar-Cane Breeding Station, Barbados, 1952, 1–30, ill. 9 plates in colour.

Imperial College of Tropical Agriculture, Trinidad

Cacao Research

65. Investigations of the nature and causes of the deterioration of cacao soils were continued. The results obtained further strengthened the opinion that the decline has been caused by the loss of litter, crumb and highly organic top-soil brought about by erosion, wastage by oxidation of organic matter and nutrient exhaustion. Methods of resuscitating worn-out cacao soils were studied, mainly in large-scale field experiments initiated since 1949 on a derelict cacao estate acquired by the College. The effects of tillages, mulch, shade, fertilizers and trace elements were observed and checked by soil and plant analysis. The soil is a sandy alluvial type, but it is hoped to repeat several of the experiments on a more clayey alluvial soil occurring at the Trinidad Government Experimental Station. Fertilizer trials were also initiated on the main soil-types of Trinidad, Tobago and Grenada within representative cacao estates.

66. The causes of marginal leaf-scorch of cacao were further investigated. This was thought at one time to be mainly due to soil potash shortage but it now appears that the excessive concentration of salts, for example chlorides, in the leaves, owing to excessive drying out, may be a cause. The role of potassium salts in this process was studied.

67. Studies of the activities of cacao bean and leaf enzymes in relation to trace elements were continued, and attempts were made to extract the proteins from cacao beans for the purpose of identification by paper electrophoresis. Three fractions were separated and all showed resemblances to globulins.

68. A Cacao-Collecting Expedition set out for the upper tributaries of the Amazon and Orinoco in Colombia. Visits were also made to plantations in the Cauca and Magdalena valleys. Much useful information and material was collected. It is expected that the expedition will continue its operations until June or July, 1953.

Banana Research

69. Hybrids of Gros Michel by new synthesized male parents were raised at the Banana Breeding Station in Jamaica in large numbers and many are now undergoing Panama disease tests. Various backcross families of these male parents and hybrids of certain African edible diploids were raised at the Imperial College and, among them, will be sought still better male parents than those now in use.

70. Shipping, ripening and tasting tests were carried on steadily with the general conclusion that virtually all the new seedling varieties currently under test can be satisfactorily carried and ripened. The seedling banana 1877, mentioned in the last Report, proved rather susceptible to leaf spot at certain seasons and localities in Jamaica and this, coupled with the very recent occurrence of a few cases of Panama disease in the variety, raises serious doubts as to its suitability for general cultivation.

71. Varietal studies included a biometrical and experimental analysis of the Cavendish Complex—an assemblage of mutant forms which comprises the economically important varieties Dwarf Cavendish or Canary, Grande Naine, Poyo, Robusta, Lacatan and so forth. Classification of the bananas collected in Africa in 1948 was continued and two of them were incorporated in breeding work.

72. Work on fruit development proceeded but met severe technical difficulties. Some interesting facts, however, emerged from co-operative work with Dr. Steward of Cornell University who demonstrated the presence of a very active growth substance which is not auxin in developing fruits. This substance is probably the same as that found in coconut milk and its discovery in bananas may prove to be of considerable significance for the whole study of fruit development.

Soils Research

73. Studies on soil structure continued and the effects of Krilium on soil structure were investigated. Soil surveys were undertaken in Jamaica, British Honduras and St. Vincent. Investigations of soil genesis from different parent rocks represented in the British Caribbean area were continued, and an attempt was begun to interpret the peculiar carbon-nitrogen relations of certain Caribbean soils.

(d) *SOUTH-EAST ASIA*

University of Malaya, Singapore

Pathogenic Fungi of Malaya

74. Mr. A. Thompson, Lecturer in Botany, University of Malaya, has collaborated with Mr. A. Johnston, Department of Agriculture, in the production of a Host-List of Malayan pathogenic fungi. This list has been sent for publication by the Commonwealth Mycological Institute, and work for a supplementary list is in active progress.

R. E. Holttum, The Sympodial Habit in Tropical Monocotyledons, Brit. Agr. Bull., 1953, 5, 319 (Summary of a paper presented to Section K of the British Association, 1952): Evolutionary Trends in a Non-Seasonal Climate (Paper presented at a Symposium on Evolution held at Oxford by the Society for Experimental Biology, July, 1952, to be published in the Symposium volume for 1953 (Cam. Univ. Press)): Gardening in the Lowlands of Malaya, Straits Times Press Ltd. (in the Press): Plant Life in Malaya, Longmans Green & Co. Ltd. (in the Press).

IV. RESEARCH PROJECTS UNDERTAKEN WITH ASSISTANCE FROM COLONIAL DEVELOPMENT AND WELFARE RESEARCH FUNDS

Gambia : Crop response to fertilizers and micro-nutrients

75. Dr. R. A. Webb continued his studies at the newly formed Yundum Agricultural Experiment Station on the need for plant nutrients in the Gambia. He found, for example, with a dwarf sorghum as indicator crop the following increases in growth: fertilizer mixture 12 per cent. ; trace element mixture 15 per cent. ; fertilizer plus trace elements 74 per cent.

Flora of Tropical East Africa

76. Mr. J. B. Gillett returned to Kew from the Kenya-Ethiopia Boundary Commission having collected over 2,600 gatherings and many sets of duplicates from the Northern Frontier Province of Kenya and from southern Ethiopia where he visited some mountains previously untouched by a botanical collector. His collection is full of rare and interesting species.

77. Messrs. J. H. Hemsley and R. B. Drummond left for East Africa, where they are collecting specimens from localities in Tanganyika from which collections had been made by the Germans earlier in the century. These collections had largely been lost with the destruction of the Berlin-Dahlem Herbarium during the Second World War, and their replacement, so far as is possible, was considered desirable.

78. Work on writing the Flora is slowly gaining momentum. Two parts were published during the year. A further twelve parts are in course of preparation.

Ecological Land-Use Survey

79. The Survey of British Honduras, the cost of which is met from a grant of £21,000 from C.D. & W. Research funds, commenced as soon as the leader of the three-man team arrived in the Colony in August. A second member was already in the Colony and the third arrived in October. By the end of the year the preliminary ground survey of the Northern, Corozal, District had been virtually completed. It is hoped that the whole survey will be finished in two years. The Survey is being followed up by the establishment of a number of small scale scatter plot trials, with the object of confirming the findings of the Survey. These plot trials include a variety of crops, cultivation methods and the use of fertilizers.

Ecological Training Scheme

80. Two research students, having completed a year's post-graduate training at Oxford, and a Colonial agricultural probationer arrived at Muguga in September, and arrangements were put in hand for the initial survey of the 1952–53 course, namely a reconnaissance vegetation survey of the West Uganda Rail Extension Zone between Mityana and Lake Edward.

81. The vegetation of a great proportion of the country was found to have been much modified by fire, grazing and human occupation, and the changes induced by these factors required simultaneous study. Particularly noteworthy were widespread indications of deterioration of former grazing areas, involving large-scale encroachments of tussock grass (*Cymbopogon afronardus*), and of short *Acacia* scrub (*A. seyal* var. *multijuga*). At the same time much light was obtained on the main pattern of climatic types of vegetation through the region, which facilitate its zoning for future development purposes.

Termites

82. The Officer-in-Charge, Termite Research Unit, was transferred to the Commonwealth Institute of Entomology and accommodated at the British Museum (Natural History). A report on "An Ecological Survey of the Termites of North-Eastern Tanganyika" was prepared, but publication awaits the completion of the specific identification of material. The general collection of termites in all the main areas of East Africa was completed by a visit to Ruanda-Urundi. Extensive collections were made in the dry country of North-Eastern Uganda and the Northern Frontier of Kenya.

Clove Research, Zanzibar

83. The work of the unit came to an end in February, 1953, with the identification of the causes of the diseases—sudden death, dieback, and slow decline—affecting clove trees.

Sudden Death and Dieback

84. Work on both these diseases continued and was extended during the year. Early results were confirmed and in addition it was shown experimentally that spores of *Valsa eugeniae* could initiate infection of uninjured roots of mature trees, and massive spore applications resulted in considerable damage to the root systems of experimental trees.

Slow Decline

85. An important and increasingly common disease of young clove trees, characterised by a slow and progressive decline over many years, followed by death, was shown to be caused by a gradual rot of the main roots, with which *V. eugeniae* was invariably associated. This disease was not found in plantations known to have been planted on virgin land, but occurred where clove seedlings had been set out in areas previously devastated by sudden death. Since young clove plants have been experimentally shown to be immune to *Valsa,* while saplings are resistant, it is considered that slow decline is the symptom-expression of attack by *Valsa* on plants which still retain some measure of juvenile resistance.

Control Measures

86. The experiments reported last year resulted in successful control of dieback on a field scale. Plans for experiments to test the possibility of controlling sudden death and preventing slow decline were drawn up in conjunction with the Zanzibar Department of Agriculture.

F. J. NUTMAN, The Relation between Climatic Factors and Transpiration in the Clove Tree, Ann. Bot. (in press).

F. J. NUTMAN and F. M. ROBERTS, (*a*) Severe Dieback of Clove Trees in the Zanzibar Protectorate, Ann. Appl. Biol.: (*b*) Two New Species of Fungi on Clove Trees in the Zanzibar Protectorate, Trans. Brit. Myc. Soc. (in press): (*c*) Sudden Death Disease of the Clove Tree *Eugenia aromatica,* Nature: (*d*) *Valsa eugeniae* in relation to the Sudden Death Disease of the Clove Tree *Eugenia aromatica,* (in press).

M. J. WAY, (*a*) The Relationship between Certain Ant Species with particular reference to Biological Control of the *Coreid, Theraptus* spp., Bull. Ent. Res. (in press): (*b*) Studies on the life History and Ecology of the Ant, *Oecophylla longinoda* Latrielle, Bull. Ent. Res. (in press): (*c*) Studies on the Association of the Ant *Oecophylla longinoda* (formicidal) with the Scale Insect *Saissetia eugeniae* (Coccidae), Bull. Ent. Res. (in press): (*d*) Studies of *Theraptus* sp., the Cause of the Gumming Disease of Coconuts in East Africa.

British Solomon Islands Protectorate: Coconut Pest

87. The economy of the Protectorate is based almost wholly on the copra industry but, owing to deterioration resulting from four years of neglect during the Japanese invasion and severe war damage, copra production has been reduced very greatly since 1941 when it stood at about 24.000 tons a year. One of the factors that has led to the low yield per tree is the increase in the numbers of the bug *Amblypelta cocophaga* which causes premature nut fall. In some places this bug is controlled by a yellow ant, but in other places the ant is absent or, if present, its activities are decreased by the presence of a predator ant, *Iridomyrmex*. Dr. J. S. Phillips, an entomologist who is familiar with the British Solomon Islands, was engaged to work on this problem which will be tackled simultaneously from two angles: (*a*) the control of the bug and predator ant by insecticides: (*b*) the control of the bug by means of introduced parasites. A grant of £6,220 was made to meet approximately two-thirds of the costs for a period of three years, the remainder being met by the Protectorate Copra Board.

Fiji

88. Colonial Development and Welfare grants, totalling £32,867, were made in the year under review to assist three research projects, namely, research into animal nutrition and climatology, a study of the flora of Fiji and nearby territories, and a survey of plant diseases.

Malaya: Reclamation of Degraded soils and Wasteland

89. Inherently infertile soils, including exhausted mining land, is unsuitable for reclamation for agriculture but given the right treatment should support trees ultimately yielding valuable timber.

90. A Colonial Development and Welfare Research grant of £7,040 was made to meet one-third of the costs of the appointment of a suitably qualified ecologist to work under the direction of the Forestry Department, Kepong, on a detailed study into the nature of the soil, as affected by the growth of indigenous and exotic cover crops and woody plants, and the factors influencing plant successions terminating in a complete forest cover.

Nyasaland: Agricultural Research and Experimental Station

91. The work at this station, which is financed in part from Colonial Development and Welfare Research funds, is referred to in paragraph 179.

Pool of Plant Pathologists at the Commonwealth Mycological Institute

92. Mr. R. A. Altson joined the Pool of Plant Pathologists attached to the Commonwealth Mycological Institute in November, 1952. He left in January, 1953, for Cyprus to investigate a disease of broad beans which has been causing considerable loss to the Island for several years.

Pool of Entomologists at the Commonwealth Institute of Entomology

93. Mr. E. S. Brown spent the whole of the year under review in the Seychelles making a detailed study of *Melittomma insulare* which is a serious pest of coconuts there. Mr. Brown was able to show that a reasonable degree of control can be obtained by the application of paradichlorobenzene. As a result of his work it was decided to launch a full scale campaign, under Government supervision, using the technique that he developed for the application of this insecticide as a fumigant.

94. The other member of the Pool, Mr. C. R. Wallace, left for British Guiana in July, 1952, to study the Padi bug, *Solubea poecila*, which is said to be a serious pest of rice in that Colony. Mr. Wallace has not yet completed his study.

United States Technical Assistance

95. Professor J. C. Matthysse of Cornell University completed his one year's investigation in Northern Rhodesia into means of controlling the tick vectors of various protozoal diseases which affect livestock in Africa.

96. Professor M. Stelly, University of Georgia, was engaged to undertake in Kenya an investigation, lasting about one year, into problems of soil fertility.

97. A further project recently approved by the Mutual Security Agency concerns investigations in West and Central Africa into pasture production and management, and the nutritive qualities of various species of grass and other locally produced feeds. It is hoped to obtain two American scientists for this work in the near future.

Research Studentships

98. Studentship awards covering periods of one or two years' study in the following subjects were made in October, 1952:

Animal Health	One
Ecology	One
Entomology	
Stored Products Pests	One
Termites	Two
Timber Pests	One
Virology	One
Plant Physiology	One

V. RESEARCH UNDERTAKEN BY COLONIAL DEPARTMENTS OF AGRICULTURE, FORESTRY AND VETERINARY SERVICES

BARBADOS

Entomological Research Projects, 1952–53

99. In the year under review an experiment was begun in the control of cane root destroying pests such as *Diaprepes abbreviatus, Clemora smithi,* Root Mealybug *Rhizoecus* sp. and *Acropyga* ants and wood ants in cane fields by an application of 13·5 lb. of BHC gamma isomer diluted to a ton per acre with milled coral limestone. Field plot tests plus pot tests showed that up to one ton of milled coral stone plus 13·5 lb. BHC gamma isomer per acre was not detrimental to cane growth in the coralline soils of Barbados, but did inhibit the growth of some weeds and was detrimental to the growth of food crops such as corn and sweet potato. No tainting of sweet potato crops was found. As a result of these tests, forty-three acres of ground were treated with gammexane and powdered limestone, distributed by mechanical distributors and harrowed in prior to " cane preparation ", and forty-seven corresponding acres were left untreated.

R. W. E. TUCKER, The Insects of Barbados, The J. of Agric. of the University of Puerto Rico, 36, No. 4, 1952, 330–363.

BRITISH GUIANA

Sugar-Cane

100. A total of forty-five varietal trials were harvested and thirty planted. The advent of leaf scald disease has become an additional factor to assess in these trials. The British Guiana seedlings produced prior to 1944 have

now been fully tested while the 1945 and 1946 series are still being tested. D.62/43 and D.37/45 have been planted, to some extent, on a commercial scale but D.62/43 has proved susceptible to leaf scald. The Barbados seedlings of 1945, 1946 and 1947 are under estate field tests and those of 1948 and 1949 are undergoing multiplication and quarantine respectively.

Leaf Scald Disease

101. Resistance trials, which include all imported Barbados varieties and locally bred Demerara varieties, have been planted throughout the cane-growing area; observations are being recorded at monthly intervals. A preliminary list of 139 varieties, showing their reaction to leaf scald, has been issued. Varieties which are to be used in the breeding programme in Barbados are under observation in resistance trials. Field experiments have been carried out to determine the loss due to leaf scald in germination, growth and final yield. All forms of natural infection and transmission are being studied. Rats have proved to be an efficient natural vector. Studies on the physiological and cultural aspects of the bacterium which causes the disease, have been concluded. Experiments are in progress to determine the effect on germination, growth and yield due to the virus disease Chlorotic Streak.

Padi Bug

102. A report on investigations into the control of this pest is given in para. 69 of the report of the Colonial Insecticides, Fungicides and Herbicides Committee.

Forestry

103. A book entitled "The Vegetation of British Guiana, A Preliminary Review" has been prepared by Mr. D. B. Fanshawe and was published in 1952 as Institute Paper No. 29 of the Imperial Forestry Institute, Oxford.

104. An expedition sent in 1952 to the Agarai Mountains in the extreme south of the Colony has returned with more than 600 botanical specimens some of which are believed to represent new species.

BRITISH HONDURAS

Land Use Survey

105. A report of the Survey is given in para. 79 of Section IV.

CYPRUS

Forage Crops

106. Research on arable forage crops to replace fallow continued. Extended plantings of vetches (*Vicia sativa*) cover some 2,000 acres, which would otherwise be fallow, and experimental production of hay and silage was successful at twenty centres. At present pastures are generally degraded and the grazing available is confined almost exclusively to short lived annuals. Field trials with possible suitable annuals and perennials, which should increase production and length of growing season, were started. These include *Phalaris tuberosa, Oryzopsis miliacea, Lolium rigidum, Medicago sativa* and *Medicago tribuloides.*

Soil and Fertilizers

107. Soil surveys of Morphou Bay salines and marshes and of certain areas in the Paphos coastal plain were conducted. A soil type in the

latter area may represent a stage in terra rossa formation. Analysis of soil samples from cotton fields irrigated with highly saline waters failed to reveal alkalization or excessive salt accumulation. Marked responses to nitrogen and phosphorus were obtained in experiments with cereals, onions, vines and citrus. Nitrogenous fertilizer, applied alone to citrus, caused marked deterioration of fruit quality ; the fruit having very thick rind, rough surface and low juice percentage. Change of colour is delayed and the total solids to acid ratio was lowered. Superphosphate counteracted this effect of nitrogen.

FIJI

Pasture

108. Work continued with pasture improvement in both the introduction of grasses and legumes and in management practice including the use of fertilizers. The grass *Ischaemum aristatum* locally known as Batiki Blue Grass and originally from India, continued to show great promise and seed was in demand by farmers. Guinea grass and *Centrosema pubescens* together form an excellent mixed pasture, the best grass-legume mixture that has been achieved so far.

Fertilizer Trials

109. The effect of artificial and locally available organic fertilizer applications on a number of food crops including rice, cassava, sweet potatoes, maize, etc., was examined. The average increase in yield of rice following applications of sulphate of ammonia was 30 per cent. but results with other fertilizers were inconclusive. Increases of up to 50 per cent. yield of roots were obtained following the applications of sulphate of ammonia to cassava.

Entomology

110. M. B. A. O'Connor, Senior Entomologist, visited Papua, New Guinea, where he found the Banana scab moth, *Nacoleia octasema,* to be under close control by a parasite. Arrangements were made for the introduction of collections of this parasite to Fiji.

Soil Surveys

111. A reconnaissance soil survey was commenced in 1952 by a team of two surveyors from the New Zealand Soil Survey. Work was started in Viti Levu Island.

GOLD COAST

Entomology

112. A further species of maize-stem borers, *Argyria psammathes,* was found attacking maize in increasing numbers and it was also found in the grasses *Pennisetum purpureum, Sorghum arundinaceum* and *Rottboellia exaltata.* The borer, *Busseola fusca,* also appears to be extending its range and this is potentially a more serious pest than the *Sesamia* species. The life history and habits of these two species are being investigated. The sampling of wild grasses was continued and *Sesamia* species continued to be found in *Pennisetum purpureum. Busseola fusca* was found in *Sorghum arundinaceum* as well as in *Rottboellia exaltata,* the only grass known to harbour it previously. A new borer was found in a swamp grass. As a result of this work the selection and control of the grass species used for fallows may need modification. Investigations of methods of control

have continued. Both DDT and BMC preparations gave control if applied at the correct time and dusts appeared more effective than sprays. The BHC preparations appeared to depress yields.

113. The appearance of many blind heads in guinea corn crops in the Northern Territories was shown to be due to attacks by the sorghum midge, *Contarinia sorghicola.* Egg laying was recorded on volunteer plants during the dry season and their removal might give some control. A programme of work was started to develop a resistant variety.

114. Investigation into the life history of the grain weevil, *Sitophilus oryzae* (*Calandra oryzae*) continued. During the wet season in Kumasi its life stages were as follows: at a grain moisture of 11·5 per cent., egg 5–8 days; larva 16–32 days; pupa 7–8 days; pre-oviposition period 2 days. The weevil was found attacking guinea corn as readily as maize. Otherwise, apart from some slight feeding on groundnuts, no other food plant has been discovered. Field investigation showed that much storage attack may start when cobs are damaged in the field.

Plant Breeding

Sorghum

115. A collection of over sixty varieties has now been established at Tamale and investigation into the cultivation of the dwarf types continued. The Plainsman type was particularly susceptible to attack by sucking insects, the Hegaris were less seriously damaged and the Shallu varieties with hard grain least of all. Crosses were made between Shallu and early maturing varieties to combine the hard grain and open head of the former with the stronger straw and larger grain of the latter. In connection with sorghum midge control, breeding work was begun to develop a locally suitable variety in which the glumes do not open at anthesis or which flowers when the midge attack is past.

Millets

116. The collection and study of local and introduced types of millet was continued.

Maize

117. Crosses between introduced maize varieties and Tamale Yellow were made and these outyielded the original Tamale Yellow. The selected progeny of these varieties was selfed and selected for earliness and uniformity. Inbred lines of the variety Tsolo were selected for rust resistance with considerable success. Other introduced varieties were grown in observation plots with controlled pollination to maintain type.

Mechanised Farming

118. Considerable work continued in the study of mechanised farming. The possibility of integrating tractor cultivation into the present pattern of peasant agriculture was also studied. This was closely linked at all stages with the development and testing of techniques of soil conservation and fertility maintenance. A wide range of tractors and implements was tested and the problems connected with their economics and management studied. Trials were also begun on the control of lalang grass by mechanised cultivation.

P. H. Nye, Studies on the Fertility of Gold Coast Soils, Empire J. Expt. Agric., 1952, 20, No. 77, 47–55.

Soils Research

119. Research performed by the Department of Soil and Land Use Survey comprises the determination of the various soils occurring in the Colony, the mapping of their distribution, the study of their morphology and the analysis of their physical and chemical composition. This work is carried out in relation to the natural and semi-natural vegetation and the cultivated crops the different soils support.

120. During the year under review the field work for the soil survey of the Accra Plains (approx. 1,500 sq. miles) was completed. A report was issued on a very detailed soil survey of a small area of Tropical Black Earths that will be used for investigations into irrigation agriculture on these soils. The Tropical Black Earths occupy a considerable proportion of the Accra Plains but are unutilized at present due to the low rainfall they receive and their intractable character. It will be possible to irrigate these soils when the Volta Dam is constructed, but their nature renders them quite unsuited to peasant irrigation agriculture and their economic utilization will depend on the adoption of some form of scientifically-controlled industrial agriculture.

121. Operations continued in the Upper Tano Basin (approx. 3,600 sq. miles). This region consists of a complicated mosaic of relict peneplane drifts, more or less broken peneplane ironstone crusts, sedentary soils and contemporary alluvia.

122. The Department's collection of representative soil profiles was considerably increased during the year. Over 150 soil series have now been recognised and described.

Forestry

123. Strip enumeration surveys continued on a large scale in Forest Reserves both in the Closed and Savannah Forest Zones. Largely as a result of these enumerations the Silviculturist was able to prepare a map showing the Vegetation Zones of the Gold Coast. Research on natural and artificial regeneration of high forest was continued.

C. J. Taylor, The Vegetation Zones of the Gold Coast, Forestry Department Bull., No. 4, 1952.

Animal Health

124. Research into the manufacture and use of Lapinised Rinderpest Virus continued at Pong-Tamale and Nungwa. The effect of the virus in various breeds of cattle was studied and also the effect of varying dosages.

125. Research has also been carried out at the Veterinary Farms at Pong-Tamale and Nungwa in general aspects of animal breeding and management.

126. In co-operation with the French authorities an extensive experiment was carried out into the protection of trade stock against trypanosomiasis. A mob of cattle, previously injected with various drugs, was travelled 800 miles from Tougan in French Territory to Accra. The animals were blood tested and weighed at intervals during the journey and valuable information regarding the efficacy of the various trypanosomiacidal drugs and the incidence of infection obtained.

JAMAICA

Bananas

127. Fertilizer and spacing trials with Lacatan bananas continued and in their first ratoon merely tend to confirm the results indicated in the previous report. Spraying and variety trials of the seedling variety No. 1877

versus Lacatan indicated that although No. 1877 was more resistant to *Cercospora* leaf spot than Lacatan, the yield of fruit was less. The trials were by no means conclusive and will be continued. Ten trial shipments of twelve seedling banana varieties carried out during 1952 showed that all the seedling varieties tested so far can be shipped successfully under the same conditions as Lacatan. Investigations into Panama disease were continued and a pot technique for testing the susceptibility of seedling varieties to Panama disease was further developed and showed great promise.

Economics and Statistics

128. Many surveys of agricultural industry and production were undertaken including assistance in an investigation into the cattle industry and surveys of the cost of production of beef, milk production, "vomiting sickness" and an evaluation of a Farm Improvement Scheme (C.D. & W. No. 1186) which is being operated by the Department of Agriculture.

Veterinary and Livestock

129. The cross bred Jersey-Sahiwal dairy cattle continued to develop along the lines planned and during the year the step of declaring the existence or a new breed, the "Jamaica Hope", was made. Herdbooks for native Zebu cattle ("Jamaica Brahmans") and for "Jamaica Reds" have also been established. Veterinary research into mineral deficiency conditions continued and the condition known as Manchester Wasting Disease was reproduced artificially in laboratory animals. Field trial of new products for anaplasmosis showed promising results.

W. D. BURROWES, Sample Survey of Production of Selected Agricultural Products 1950, Bull. No. 48, Department of Agriculture, Jamaica, Investigations 1950–51, Bull. No. 49, Department of Agriculture, Jamaica.

P. D. L. GUILBRIDE, The Importance of Animal Disease to Public Health in the Caribbean, with Special Reference to Jamaica, W. Indian Medical J., **1**, 105.

M. S. MOTTA, Grasses and Fodder Resources in the British Tropics, Empire J. Expt. Agric., 20, No. 80.

KENYA

Grassland

130. The Pasture Research Section, the re-organisation and expansion of which is now well forward, continued to give priority to ley problems: in the search for better ley species a large collection of species and ecotypes of grasses and legumes has been established at Kitale. Strains of *Setaria sphacelata, Panicum maximum,* and *Brachiaria brizantha* showed considerable promise, and passed beyond the initial testing phase. Although there is an exceptionally wide range of indigenous legumes few of them appear to be capable of making a really useful contribution to the sward. An exception is to be found in those areas where *Trifolium semipilosum* grows well, and work on strains and seed production of this species was begun at the high altitude station. Other legumes which show promise are *Alysicarpus glumaceus, Glycine javanica,* and lucerne.

131. Fertilizer experiments on leys showed that phosphate usually has a very marked beneficial effect on grass establishment and increases yields of dry matter if applied with nitrogen. Both on leys and permanent grass

nitrogen produces very appreciable yield increases. Both fertilizers increase the yield of crude protein. Potash and lime had not effect in any of the experiments in which they were included. The results indicated that there were considerable possibilities for the use of nitrogen and phosphate on leys, but on permanent grass, although increased production was obtained. it was of lower value, and as its utilization necessitates increased provision of stock, fencing, water, etc., it was doubtful if it was at present practicable or economic, on a large scale.

Fertilizers in African areas

132. Fertilizer experiments were conducted in parts of the Coast, Central and Nyanza Provinces, being a continuation of previous work by the East African Agriculture and Forestry Research Organisation in the last-named Province. They showed that marked and economic response to phosphate can be obtained over wide areas on a variety of soils. Further investigation is in progress to determine optimum rates of application, residual effects, the most economic type of phosphate to use, and the interaction of phosphate with farmyard manure.

Coffee

133. Research aiming at improving biological control of the common coffee-mealybug (*Planococcus kenyae*), by introducing and establishing further species of natural enemies from Uganda, continued with increased insectary breeding of a new species of *Anagyrus* and three species of predatory *Coccinellidae* imported in 1951. Field liberations of the *Anagyrus* and one species of *Coccinellid* were carried out in the East Rift coffee areas. No field recoveries were recorded in the year under review, but experience with previous introductions has shown that a considerable period may elapse before establishment is confirmed. The very beneficial effects which grass mulching exerts, both on the crop and on the soil structure, in coffee plantations has been already amply demonstrated. An interesting comparison was made between the effects of an elephant-grass ley and a grass mulch in increasing the structural efficiency on eroded and worn out land.

It was found that two years of grass mulching had improved the structural efficiency of the soil to approximately the same high level as that reached after five years of grass ley. The mulch also had the advantage that it did not draw on soil moisture reserves, whereas the deep-rooted elephant-grass depleted soil moisture to a considerable depth.

Forestry

134. Nursery techniques especially directed to improvements in the raising of Pinus species were investigated under the guidance of the East African Agriculture and Forestry Research Organisation's Horticulturist. A general improvement in large scale raising pines is already apparent. A large number of exotic coniferous species, mainly Pinus, were introduced, or re-introduced experimentally. Most of them have good prospects of survival to the planting out stage. Significant responses by pines to nitrogen and phosphate application hold out prospects of reducing their nursery periods and of bringing plants on to the requisite size for planting out at the appropriate season.

Veterinary Research

Contagious Bovine Pleuro-Pneumonia

135. A notable advance was made in the control of contagious bovine pleuro-pneumonia (C.B.P.P.) using a new avianized vaccine made from a strain of the C.B.P.P. organism attenuated in fertile eggs. The viability of

this vaccine, which is issued as a dried product, remains unimpaired for at least six months when stored at -25° C. Each batch can, therefore, be titrated and tested for safety in cattle before issue. A single subcutaneous dose of one c.c. proves effective against challenge with virulent "lymph". About a quarter of a million doses were used, mainly in the endemic areas of the Samburu Reserve in Northern Kenya where no fresh cases of the disease were reported in any of the vaccinated herds. Notable success was also achieved in some of the Masai pleuro-pneumonia quarantines in which the disease had existed for many years. Small amounts of vaccine are being tried out in Tanganyika and the Sudan.

Rinderpest

136. The continued use of attenuated rinderpest vaccine (7,000,000 doses of goat adapted virus, and 700,000 doses of lapinised virus) kept this disease well under control. The popularity of lapinised vaccine continued to grow and there was a steady tendency for this product to take the place of inactivated spleen vaccine in the immunisation of high-grade and pure-bred stock. Techniques of production were further improved. Tests showed that K.A.G. vaccine remained viable for at least two years and lapinised vaccine for at least fifteen months when stored at -25° C., and for some three months in both cases when stored at -5° C. The immunity engendered in highly susceptible cattle by lapinised vaccine exceeded expectations and may be of two years' duration or longer.

Mineral Deficiencies

137. A Colony-wide mineral survey, designed to estimate the extent to which Kenya cattle may be suffering from mineral deficiencies, such as phosphorus and copper, was begun. Evidence of widespread aphosphorosis is accumulating rapidly.

Zoology

138. The ecological requirements of *Glossina austeni* were studied at Kilifi. The control of *G. palpalis* by the spraying of riverine bush with insecticides was shown to be economical and efficient. The elimination of tsetse-infested bush by bulldozers was found to be not only much more rapid than hand clearing, but to be much more costly. Investigations with the efficiency of mechanical spraying of cattle for the control of tick infestation, as compared with the traditional dipping methods, were undertaken.

MALAYA

Rice

139. Pure line selection is proceeding in eleven major local varieties, but almost without exception introduced varieties proved too lacking in vigour under local conditions to justify attempts at improvement by this method. Improvements in yielding capacity, straw strength and response to fertilizers were attempted by hybridisation of *japonica* types with selected local *indicas*; F_2 progenies lacked in vigour and fertility but present a wide range of material for selection and backcrossing.

140. Liberation of over 8,000 individuals of *Paratheresia claripalpis* v.d. Wulp. was carried out between April and October to test parasitisation in the field of *Proceras polychrysus* (Meyr.) and *Chilo suppressalis* (Walk.); no recoveries were made by the end of the year.

141. A survey of incidence of "penyakit merah", an ostensibly non-parasitic disease causing leaf discoloration, stunting and poor root development, was begun and experiments were undertaken to relate this condition to deficiency or excess of major elements.

Cacao

142. Insect pests are proving among the more troublesome factors in field establishment of young cacao. The chafer *Apogonia* affecting cacao locally was found to include both *A. cribricollis* Burm. and *A. expeditionis* Rits; a smaller species *A. aeneocuprea* Msr. causes relatively minor leaf injury. An unidentified *Tiphia* was found parasitising *Apogonia* larva, but exerted only negligible control. Control was effected by soil treatment with BHC and dusting the plant with DDT wettable powder. Investigations were undertaken to control other pests of this crop including *Helopeltis theobromae* Miller, and two newly recorded pests, the leaf-eating longicorn *Glenea funerula* Thoms. and the shoot-boring weevil *Alcidodes* sp. Establishment experiments indicated that introduced Amelonado types were more productive and vegetatively more vigorous than either Trinitario or local Criollo types, the last being particularly susceptible to insect damage.

Oil Palm

143. Analysis of oil yield of the past five years at the Federal Experimental Station, Serdang, show the yield of fruit and oil per acre to be appreciably higher from "dumpy" than from tall Deli palms.

Tea

144. No outbreaks of blister blight (*Exobasidium vexans*) in lowland tea were recorded during the year, and it appears unlikely that this disease will cause serious damage at low altitudes. Investigation with different fungicides and methods of application for control of blister blight showed that proprietary copper oxide and copper oxychloride preparations were more satisfactory than copper naphthenate and other organic fungicides; that spraying must be carried out at not more than weekly intervals but that the strength of copper sprays may be reduced by half, i.e., to 0·125 per cent., and application made with low-volume nozzle equipment at ten to twenty gallons per acre. It was shown that, in the absence of blister blight, copper sprays show promise of improving quality of local tea, in which copper uptake is normally low, by increase of the polyphenol oxidase enzyme action in the leaf.

Soils

145. Timber from *Melaleuca leucodendron* (gelam) from sulphurous "gelam" soils showed, by analysis, a content of 0·28 per cent. sulphur as compared with 0·004 per cent. to 0·05 per cent. when grown on normal soils, indicating an abnormally high sulphur uptake. Mitcherlich pot experiments showed that rice on these soils give a marked response to dressings of NPK and lime. Investigations of aluminium toxicity were extended to other crops, and it was found that oil palms in hydroponic culture can tolerate concentrations of aluminium sulphate as high as 2 per cent. in the culture solutions. Application of lime was found essential to the growth of maize, soya beans and tomato on peat soils; the non-parasitic disease of pineapples, green dieback, common on these soils as a result of copper deficiency, may be effectively controlled with copper sprays.

J. K. COULTER, Gelam Soils, Malayan Agric. J., 35, 22.

R. B. JAGOE, The "Dumpy" Oil Palm, Malayan Agric. J., 35, 12, ill.: Notes on Current Investigations, Malayan Agric. J., 35, 36, 105, 167, 218.

MAURITIUS

Seed destroying species of Eurytomidae

146. The fruit-infesting insect, *Eurytoma* sp., was introduced in 1949–50. Well over two million fruits of *Cordia* were sent from Trindad and from the many different species of insects which emerged the *Eurytoma* were selected and released. No feeding tests were first carried out, for the highly specialised mode of life of this insect was considered a sufficient guarantee of its food-plant specificity. The introduction of *Eurytoma* was an immediate success, it quickly became established and its natural dispersion was aided by initiating colonies in various regions. It now infests *Cordia* fruits wherever the bushes are to be found. Data regarding the degree of fruit and seed infestation showed that the fecundity of *Cordia* bushes was being considerably reduced by the activity of the insect. In 1951, fruits were collected from most of the areas of initial colonisation and the average percentage of seeds found to have been destroyed was near 50 per cent. Similar data showed that during certain months figures of 70–80 per cent. seed destruction were not uncommon. As with *Schematiza,* the intense activity of the insect was associated with the fact that its parasites were excluded when it was introduced.

NIGERIA

Cacao

Soil Survey

147. Systematic mapping of soils was started for the first time in Nigeria by the Soil Survey under Dr. Vines, and in the year under review a reconnaisance soil survey of 3,000 sq. miles of the cocoa belt of Ibadan and Oyo Provinces, which totals about 4,500 sq. miles, was completed.

148. The reconnaisance survey involved the sampling, description and recording of about 9,000 soil profiles along a grid of parallel traverses, and recording of the vegetation type or land-use at each of these points.

149. The soils are classified into series which are the main units used in the detailed and semi-detailed surveys of special areas, and the sub-types of profile found within each series are also being recognised and recorded. As work proceeds, the soil and vegetation records are being plotted on maps on the scale 1 : 62,500. The summation of these records will give an accurate picture of the amount of each soil that occurs and its present use.

150. A semi-detailed soil survey of the Ijebu Plantations Project comprising twenty-one sq. miles was carried out early in 1952 and the Western Region Production Board were supplied with a soil map showing soil boundaries and approximate contour lines together with a cropping plan.

151. The results being achieved by the survey will shortly be published in the form of special reports and maps.

Plant Breeding

152. An interesting case of hybrid vigour in cocoa was reported in a yield trial comparing the selfed progeny of a Nigerian cacao of a Trinitario type with selfed seedlings of a Trinitario cacao from Trinidad and with hybrids of the two types. The hybrid seedlings showed marked superiority in vigour of growth and in early production. The greater yield resulted from the larger number of pods produced rather than from greater bean size.

Plant Pathology

153. Studies by Mr. Thorold on the control of black pod disease of cocoa (caused by *Phytophthora palmivora*) have shown that the disease is mainly spread by the sporangia produced on the surfaces of affected pods both on the tree and on the ground. Some of the black pods which remain on the ground during the dry season may produce sporangia during the following wet season. The sporangia have been shown to be air-borne up to a distance of seventy-five yards from an affected tree.

154. Two methods of control were investigated in the field: inspection of trees with removal of pods, and frequent spraying with Bordeaux Mixture. It has been found that trees must be inspected every day or at the least every other day in order to ensure that pods producing sporangia are not overlooked since it has been shown that the interval between the time black pods symptoms are first visible and the commencement of production of sporangia on the affected area of the pod may be only two days.

155. A modified form of Bordeaux Mixture was adopted to avoid certain difficulties inherent in the use of quick lime under tropical conditions. After trials it has been found that an interval of three weeks between applications is the most satisfactory minimum period. It is anticipated that this interval may be extended if cocoa spraying becomes an established practice in Nigeria. In a large scale experiment on farmers' cocoa there was apparent reduction in black pod losses amounting to over 70 per cent. attributable to spraying.

156. Further research is being directed to reducing the cost of the operation and improving the economies of spraying by the inclusion of insecticides for the control of capsid damage, as well as by reducing the frequency of application.

Maize

157. A report of work on maize rust is given at paras. 55–56 of Section III.

Sorghum

158. Plant breeding work in Nigeria received a stimulus by the visit of Dr. O. J. Webster, Assistant Professor of Agronomy, University of Nebraska, who came to Nigeria under the United States Economic Co-operation Administration Technical Assistance Scheme.

159. After a survey of the sorghums growing in Nigeria, Dr. Webster established a breeding programme with two objectives: (i) to develop varieties better adapted to the resettlement areas, with shorter stalks to permit easier harvesting and to reduce grain loss from stalk lodging; (ii) to develop varieties similar to those now being grown but with the sorgo characteristic of sweet juicy stalks which would permit a more palatable pasture or fodder for livestock grazing in the early part of the dry season.

160. In addition to carrying out trials of introductions, hybridisation and selection for suitability for local conditions, special attention is being paid to tests for resistance to pests such as stem-borers, striga root parasites and smut diseases of the grain, and to the development of short-strawed types suitable for mechanised farming.

161. Work started on this programme at the Northern Regional Research Station at Samaru, with out-stations at Daura, Kano, Riyom and Mokwa.

162. During his stay in Nigeria, Dr. Webster drew attention to the yellow pigmentation in the endosperm of the short Kaura variety. Further work

in the United States of America shows this pigment to be carotin, and it is stated that the quantity contained is on the same level as that in yellow maize. Considerable importance is attached to this and a breeding programme is now being conducted by Dr. Webster on short Kaura in the United States.

Sugar-Cane

Red Rot Disease

163. A serious outbreak of disease in sugar-cane fields was observed for the first time in Nigeria in October, 1951. The disease was later reported over a wide area in the Northern Region ranging from Sokoto to Daudawa, Makarfi and Maigana. The disease was diagnosed as red rot, caused by *Colletotrichum falcatum*. The pathogen was isolated in pure culture and found to be the light coloured strain. A characteristic symptom of the disease in Nigeria is the drying up of the middle portions of the canes indicating that the most common source of infection in this epidemic appears to be aerial, with the pathogen working downwards in the stem.

164. The type of sugar-cane grown is a local soft one used mainly for chewing, and very large quantities are consumed raw. In addition, some 60,000 tons are crushed annually for the manufacture of brown molasses sugar.

165. Steps are being taken to introduce material of red rot resistant varieties from the leading sugar-cane breeding stations in Africa and India, and research on control measures is also being undertaken.

T. A. Russell, The Vigour of Some Cacao Hybrids, Trop. Agric., 1952, 29, 102–106.

C. A. Thorold, Airborne Dispersal of *Phytophthora palmivora,* causing Black Pod Disease of *Theobroma cacao,* Nature, 1952, 170, 718: The Epiphytes of *Theobroma cacao* in Nigeria in Relation to the Incidence of Black Pod Disease, *Phytophthora palmivora,* J. Ecol., 1952, 40, 125–142.

J. M. Waterston with D. Rhind and F. C. Deighton, Occurrence of *Puccinia polysora* Underw. in West Africa, Nature, 1952, 169, 631.

Forestry Research

166. During the year investigations were undertaken into various problems connected with the regeneration of the rain forest, particularly by the system known as Tropical Shelterwood. The senior botanist is seconded to Kew where he is working on the revision of the Flora of West Tropical Africa.

Veterinary Research

Rinderpest

167. Work aimed at developing an inactivated vaccine which may prove more suitable than lapinised virus in Nigeria, and work on a serological test for rinderpest antibodies was begun.

Contagious Bovine Pleuro-Pneumonia

168. Efforts were made to develop a test for the diagnosis of the disease in the field: promising results were obtained and a whole blood agglutination test is being explored. In this connection the preparation of antigens is being investigated and some successful batches have been produced. Work on the determination of the immunity conferred by vaccine continued; the

degree of immunity is being correlated with the antibody response as determined by the complement fixation test. Isolation of the organism of pleuropneumonia on solid media was the subject of experiment.

Newcastle Disease

169. With the confirmation of the presence of this disease in Nigeria work started on setting up a satisfactory laboratory diagnostic service and experiments were directed towards the production of an egg-adapted vaccine.

Bacterial Disease

170. Investigations continued on the methods of vaccine production. An effort was made to overcome the difficulty that had seriously impeded progress in the past, namely, the isolation from field outbreaks of strains of organisms, particularly *Clostridia* and *Pasteurellas*, suitable for challenging experiments and for inclusion in vaccine produced. Experiments to find means of producing vaccine more economically by concentration methods such as growth within dialysing membranes and centrifugation were carried out.

NORTHERN RHODESIA

Tobacco

171. Work on flue-cured Virginia and Turkish tobacco was continued on several lines which included:

Seed-bed experiments

172. These comprised watering by capillary action with the object of eliminating overhead watering economising in labour replacing soil by vermiculite and applying plant food material in solution. The intention is to have permanent seed-beds and avoid the onerous and expensive task of sterilization each year.

Root-knot eelworm (*Heterodera marioni.* Cornu.)

173. A study of the effects of two different types of compost applied at varying rates of application three to four weeks after transplanting to tobacco planted in soil known to be heavily infested with eelworm. The object of this experiment is to see whether this top dressing of compost, applied around the stem of the plant, will induce the production of rootlets in that area which are capable of carrying the plant through satisfactorily when the original set of roots have become so infested with eelworm that they are no longer capable of absorbing plant food material to the full extent.

174. A comparison of the effects of Ethylene dibromide and D.D. as soil fumigants on the eelworm population of the soil and on the growth and quality of tobacco grown in soil heavily infested with eelworm and treated with these fumigants.

Soil Surveys

Sugar

175. About 1,000 acres of land were surveyed and mapped in the Gwembe Valley near Chirundu in connection with a pilot sugar-cane plantation. Two-thirds of the area might be suitable for sugar-cane cultivation—with irrigation by pumping from the river Zambesi. The remaining one-third of the area contains excessive amounts of soluble salts, mainly sodium sulphate, and is probably unsuitable for cultivation without great expense on ameliorative treatments. The survey will be continued in 1953 and a soil map of some forty-five square miles will be made using details obtained from ground traverses in conjunction with aerial photographs.

Kafue Flats

176. Several reconnaissance surveys were made in connection with the soil survey of the Kafue Flats required in connection with a proposed large-scale irrigation scheme. The soils of the fringing zone seem to present the greatest possibility. Being nearest the escarpment they are affected by the sandy material to the greatest extent, and so the texture of the profiles changes from one predominated by heavy intractable clay to sandy loams and sandy clay loams. The top soil though is still shallow and deficient in humus.

Veterinary

Control of Tick-Borne Diseases

177. During the past year Professor J. G. Matthysse, Entomologist, of Cornell University, investigated in Northern Rhodesia various aspects of tick-infestation of livestock, and particularly the control of tick-infestation of cattle. The efficacy of the various modern insecticides were compared and a number of methods of applying insecticides to cattle were studied. Various insecticides were applied by means of dip washes, sprays and fogs. The present indications are that the deposition of insecticides on the skin or hair of animals through the agency of fog generators is less likely to be effective than by liquid sprays or dip washes. Liquid sprays and dip washes compare more closely in effectiveness for destroying ticks attached to the body.

178. An important development in this field indicates that under conditions commonly prevailing in Africa there appears to be a very wide field of application for the portable power-spray. Many disadvantages of the dip are avoided and as many as 350 head of cattle per hour can be effectively sprayed, giving adequate and satisfactory tick control for normal conditions. The portable sprays operated through gear pumps at a pressure of between 80 lb. to 120 lb. to the square inch driven by a light portable 3½ h.p. petrol engine. Only simple cattle-handling facilities are required, which can be moved from place to place as occasion demands to avoid the danger of soil erosion from tramping.

NYASALAND

179. Research and experimental work is now co-ordinated from the new Agricultural Research Station at Lilongwe. Mr. S. T. Hoyle, Chief Agricultural Research Officer, is in charge of the Station and he is responsible for the experiments carried out by the Department of Agriculture other than those at the main commodity stations which deal with tea and tung. The Station is mainly concerned with annual crops.

Fertilizers

180. One of the most noticeable results of the trials so far conducted was the remarkable effect of nitrogen and the evident need there is for this element under local conditions. Not only is this so in the case of maize and tobacco, but also on tea and tung. In general, a dressing of 100 lb. per acre of sulphate of ammonia gave a highly significant response, but only in the case of tobacco and tea was the response linear for dressings in excess of 100 lb. The response of maize to nitrogen, although highly significant, was rarely economic at the present price of one penny per pound to the grower.

Maize

181. Considerable progress has been made towards establishing a large number of pure lines of inbred flint maize. Preliminary tests of yielding

capacity of some lines will be made in the coming season though a commercial hybrid cannot be expected for several years. Numerous commercial maize varieties were tested and the Station can now advise on which are the best to plant.

Tobacco

182. Although the dark tobacco in general cultivation is capable of giving high yields it is somewhat mixed. The work of selecting improved types has reached the stage when it is expected that an improved strain will be issued on a fairly large scale for planting in the 1953–54 season. Problems of cultivation and fertilization were also investigated and work in progress, in addition to fertilizer trials, includes spacing and topping trails and the introduction of American Burley and new dark-fired types. Work on flue-cured tobacco was carried out at the Lisasadzi Experiment Station in the Kasungu District and consisted of strain trials and fertilizer trials. It was shown that there was little to choose between the strains so far tried in the field and that it was not likely that variey would influence the yield so much as other factors. Fertilizer trials showed no advantage for applications of phosphate or potash but a strong reaction to nitrogen.

Pastures

183. A large number of grasses were imported from other countries and selected within the country. Many of these proved unsuitable, and a small number were retained for further testing. The most outstanding grass for short leys is Rhodes Grass (*Chloris gayana*) which did well at all stations. Strains from Teso (Uganda) and Mpwapwa (Tanganyika) did particularly well and are being bulked up for general distribution.

Stock

184. In co-operation with the Veterinary Department, the Agricultural Research Station became the Livestock Improvement Centre for the Central Province. The herd maintained on the Station was combined with that of the Veterinary Department to give a herd of some 100 head of cattle on the Station: this number will be increased. The breeding policy was under the direct control of the Veterinary Department, while the general management and feeding of the Station herd was undertaken in co-operation with staff provided by the Veterinary Department.

Livestock and Veterinary Research

185. With the aid of a grant provided from Colonial Development and Welfare funds Livestock Improvement and Animal Industry Centres were started in each of the three Provinces. Foundation herds of indigenous Angoni cattle were formed at two of the Centres and a herd of Nyasa Shorthorn Zebus at the third. Foundation flocks of Nyasa sheep and goats were also formed at each of the Centres and at the Southern Province Centre a start was made on a poultry unit. A small but well equipped Research Laboratory, also made possible by Colonial Development and Welfare funds, was completed at Blantyre. Routine diagnosis and *ad hoc* investigations were undertaken.

SIERRA LEONE

Animal Husbandry

186. Investigations into the breeding, feeding and management of Ndama cattle; pasture research; and the behaviour of Wessex Saddleback pigs

were carried out at the Animal Husbandry Station at Musaia. Whilst improvement in the Ndama milk yield was obtained by improved management and feeding it is safe to conclude that this would never make an economic milk type. Of the 229 animals now at the Station, half were run as a dairy herd and half as a beef herd on free range under natural conditions. Calf mortality was higher in the dairy herd, the young animals persistently refusing to thrive on bucket feeding. Accordingly concentration is to be on grading, selection and breeding for beef—the herd being run under natural conditions with dry season improvement in grazing utilizing Yanni grass (*Axonopus compressus*) under irrigation and pueraria.

Agricultural Chemistry

187. Investigations in the field and laboratory were made on soils of the mechanized swamp-rice sites and *Lophira* bush soils for groundnuts. A wide series of fertilizer trials throughout the country confirmed superphosphates as economic for swamp-rice and legumes, and potash for root crops and most tree crops: nitrates gave little response except in the sandy Colony soils.

Plant Pathology

188. The Plant Pathologist was engaged on taxonomic studies, in connection with the preparation of a revised list of Sierra Leone fungi and plant diseases, with a corresponding host index. The final list will probably contain between 1,100 and 1,200 fungus names. Especial attention was given to the genus *Cercospora* (a common cause of leaf spots) of which there appear to be over 100 species in Sierra Leone, about forty of which it is proposed to describe as new species.

TANGANYIKA

Cotton

189. Soil fertility experiments at Ukiriguru indicated a remarkable response over two seasons to "tumble-down" fallow on previously worn out land. On such a fallow the deep-rooted weed *Tridax repens* quickly becomes dominant, and there is a suggestion, now being followed up, that it acts as a procurer of phosphate. At Ilonga insecticide experiments were accentuated by the heaviest infestation of American bollworm ever known on the Station; 44,000 per acre were recorded in early June. A dust containing 10 per cent. DDT and 3 per cent. Gamma BHC proved the most satisfactory and the best results were obtained with six applications during the season; treatment yields averaged 1,400 lb. of seed cotton per acre compared with 13 lb. per acre on the control plots, a virtual failure.

Sorghum

190. The Botanist at Ukiriguru and his African staff became adept at the hot water method for emasculating sorghum heads, and many crosses were made. Breeding work was expedited by taking an extra crop under irrigation during the dry weather, and new strains of considerable promise are beginning to segregate. Further evidence regarding the partial resistance of the Dobbs variety to *Striga* was obtained, and it is hoped to breed this character into all new strains of promise.

Bananas

191. Many local varieties of bananas were tested, on infected land, for resistance to the wilt disease (*Fusarium oxysporum* forma *cubense*). Early results which must await confirmation indicated very considerable variation in susceptibility to Panama disease, and one variety appeared to be immune.

Wheat

192. Wheat fertilizer trials in the Southern Highlands confirmed the previous large increases obtained with organics, and satisfactory increments of yield were again given by the single superphosphate dressing (50 lb. P_2O_5 per acre) in Iringa: for the first time a significant response was recorded on the potash plots.

Pyrethrum

193. Striking results were obtained from the use of superphosphate (soda-phosphate has no effect); on one farm a dressing of 300 lb. per acre at planting gave in three years additional crop to the value of £44 per acre. No significant results were obtained from spacing experiments, but the system of planting single rows on the contour at 6 inch spacing and thinning to 12 inches in the second year was shown to have many practical advantages. Breeding for high pyrethrum content proceeded steadily.

Sisal

194. The programme of experimental work on the Tanganyika Sisal Growers' Experiment Station comprised thirty-six field trials of which all but nine were concerned with soil fertility and fertilizers and were of a very long term nature. In the factorial manurial trial on second cycle sisal now in its fourth year there was clear evidence that nitrogen had hastened growth, and on the only five plots which had been cut three times yields were comparable with those on virgin land. There were two experiments in progress testing selected agave hybrids; out of nineteen selections, four are promising. Tests on tissues from the manurial trial showed a clear relationship between application and uptake of potash and phosphorus, but the latter was also conditioned by the presence of nitrogen. The private firm engaged to investigate the control of sisal weevil completed its work.

Animal Diseases

195. Studies, limited by staff shortages, were undertaken at the Veterinary Laboratory, Mpwapwa, on the following problems:—

(*a*) The effect against *Trypanosoma Congolense* in Zebu cattle of three new Phenanthridine compounds administered at varying dosage levels to susceptible cattle. One of the drugs tested proved well worthy of further field trials.

(*b*) A comparative virulence trial of two strains of *Salmonella gallinarum* with a view to isolating an avirulent strain for use in Fowl typhoid vaccine production.

(*c*) The initiation of an experiment directed towards the reproduction of the ill effects occasionally resultant upon the use of typhoid vaccine under field conditions.

196. Fundamental work on livestock research was carried out at Mpwapwa with extension work at four stock farms situated in four different ecological zones within the territory. Recording work devoted towards the collection of livestock breeding and production data from these four main stock farms was extended to a number of smaller Government stock farms and dairies.

Pasture Analysis

197. An experiment was begun to determine the monthly variation in chemical composition and growth rate of typical pastures under various cutting treatments at eight farms, each representative of a different environment within the territory. The experiment was centrally controlled and replicated three times on each type of grazing at each farm.

198. Monthly samples were also taken at each farm of herbage selected by grazing cattle—the assistant following marked individual animals whilst grazing, and collecting samples as nearly equivalent as possible to each mouthful taken by the experimental animal.

Experimental Physiology

199. An interim paper has been submitted for publication on "normal" temperature studies among local Tanganyika cows during the dry season.

H. G. HUTCHINSON and R. M. MABON, Studies on the Environmental Physiology of cattle in Tanganyika, Preliminary Observations on the Seasonal Diurnal Variations in the Rectal Temperature of Local Zebu Cattle.

200. A number of analyses were made of blood samples drawn from local Zebu, and various crossbred cattle, of various ages, to obtain information on the variation within the various herds of cattle maintained under different husbandry conditions at Mpwapwa. Most attention was given in the year under review to blood phosphates.

201. Notes of the preliminary data obtained from some of the blood phosphate analyses have been prepared:

A Note on Levels of Blood Phosphate in Adult Cattle at Mpwapwa;

Observations on the Blood Inorganic Phosphate Levels of Local Zebu Calves during the Dry Season;

A Note on the Variation in Blood Inorganic Phosphate Levels arising from Treatment and Method of Storage of Blood Samples taken in the Field.

Fertility in Cattle

202. A statistical investigation into the heritability of fertility in cattle, and factors affecting fertility based on a large amount of data collected from artificial insemination centres in the United Kingdom was carried out in conjunction with the Institute of Animal Genetics at Edinburgh.

Pasture Research

203. Pasture Research work during the year was focussed on a number of major problems including:—

1. The eradication of undesirable thicket-forming bush and the control of regeneration.
2. Studies on the effects of fire on vegetation particularly in relation to woody plants.
3. Investigations to test the effect of chemical agents and selective weed-killers on undesirable species.
4. The cultivation of fodder plants, the selection and propagation of suitable grasses for establishing from seed.
5. Determination of the value of grass against erosion and its usefulness in general farming practice.
6. Studies in the utilization of indigenous browse plants and pod-bearing trees.

204. In addition to the two main centres at Mpwapwa and Tabora, pasture research work was extended to Government stock farms and investigation centres in the Southern Highlands, Lake, Northern, Tanga and Eastern Provinces.

H. J. Van Rensburg, Grass Burning Experiment on the Msima River Stock Farm, Southern Highlands Province, Tanganyika, E. African Agric. J., 1952, 17, No. 3, January.

TRINIDAD

Central Experiment Station

Rice

205. Further trials confirmed that no economic responses to fertilizer can be expected where average yields are in the region of 2,500 lb. per acre and over. The collection and classification of local varieties continued and pure line stocks should shortly be available for testing.

Coconuts

206. Investigations into red ring disease (*Aphelenchoides cocophilus*) showed that it was spread by the coconut weevil (*Rhynchophorus palmarum*), which burrowed in the debris of larval tunnels made in diseased tissue. Control can be effected by cutting up the trunks and petioles of diseased palms and ensuring their complete destruction by fire. It was also shown that spread of the disease via the soil did not normally take place.

Seedling Lime Disease

207. Investigations on this disease continued. Although the cause remained obscure, grafting and budding experiments indicated that the disease was not due to a virus. A species of *Fusarium* was isolated from diseased tissue but inoculation experiments gave negative results.

Weed Control

208. Preliminary trials on the control of blackstick (*Pachystachys coccinea*) in cacao with various 2-4-D formulations gave encouraging results.

Veterinary

Rabies (Bat transmitted)

209. Limited experiments were carried out to evaluate the antigenic powers of different preparations of phenolised tissue vaccines, with special reference to the duration of resistance established.

Newcastle Disease and Fowl Pox

210. Trials were carried out to determine the comparative value of live versus killed virus vaccine in the protection of day old chicks. Results, so far, disclosed that, on the assessment of HI titres following vaccination as an indication of resistance, there was no response following the use of killed virus. Three day chicks were vaccinated against Fowl Pox and others, as an experiment, against both diseases simultaneously.

Animal Husbandry

Cattle

211. Breeding work continued with the object of establishing a type of animal adaptable to local conditions. An attempt was made to study the part which nutrition plays, if any, in relation to the reproductive efficiency of cattle. In this connection, a preliminary survey was started on the determination of blood levels of calcium, phosphorous, magnesium and haemaglobin in relation to such factors as soil type, class of feeding, stage of pregnancy and lactation.

Pastures and Fodder Crops

212. Observations continued on the value of high quality grasses as the sole maintenance requirement of dairy cows. Limited trials on the value of the application of artificial fertilizers to pasture grasses were carried out.

Forestry

213. Several experimental plots of Pine (*Pinus caribaea*) in different localities were planted in June. Survival was 95 per cent. in most of the plots. Growth was satisfactory at first but by October most of the trees had turned a bad colour and stagnated. This problem is being investigated. At the time of planting, all the plants had mycorrhiza. The use of fertilizer and manures is being tried in the plantations. Plants left in nursery beds grew very well and did not turn yellow.

214. Experimental plantations were made on the Northern Range after a lapse of over 15 years. It is required to find the best conditions for the species which are suitable for the dry hillsides. The species being tried are cedar (*Cedrela mexicana* Roem), cypre (*Cordia alliodora* Cham.) and mahogany (*Sweitenia macrophylla* King). Growth during the first year was rapid and the plants were healthy.

R. S. Ayliffe, The Natural Regeneration of Trinidad Forests (Sixth British Commonwealth Forestry Conference, Canada, 1952).

UGANDA

Cotton Breeding

215. Intensive selection for blackarm resistance within Gambia x BP52 hybrids back-cross to BP52 had produced strains with high resistance to stem infection. At Kawanda a severe hailstorm followed by heavy rain in August, 1952, produced conditions highly favourable to infection, and the selected strains withstood attack remarkably well.

Entomology

216. Small and large-scale field trials, carried on with the help of a field officer seconded by the Colonial Insecticides Research Unit, showed that substantial increases in cotton yields can be got by spraying weekly with 1 lb. technical DDT per acre in as little as six to 10 gallons of water, during the period of attack by *Lygus voggeleri* Popp.

217. The Entomologist found that the root-knot eelworm, *Meloidogyne* sp. (*Heterodera marioni* Cornu), a serious pest of tobacco, was widespread and not confined to seedbed areas. Under the system of peasant agriculture prevalent in Uganda control measures may not be similar to those in more advanced countries, and trials are in progress to discover whether the seedbed infection is of primary importance or not.

Soil Fertility Studies

218. Investigation of the natural build-up of nitrate in the soil, which is closely linked with the utilisation of nitrogenous fertilizers, was continued. In addition to following the weekly nitrate fluctuation in surface soil (which was begun in 1949), its distribution was studied to a depth of six feet. Peak accumulations of nitrate were found at depths varying with the cropping history of the site. Under old grass leys, the nitrate status of the whole profile was almost nil and on opening up the ley the rate of build-up of nitrate, beginning in the surface soil, varied with the type of grass dominant in the ley. Inch by inch examination of the soil to a depth of one foot showed the nitrate level to be highest in the top inch.

Soil Infertility Studies

219. Certain soils which produce either very poor crops or no growth at all were examined and preliminary results indicated that a very high content of available manganese may in some cases be the cause of the

trouble. One specific investigation was carried out: the study of the chemistry of the " dead " papyrus swamps of the Kigezi District. When these swamps were drained, cleared and cultivated for about five years, several patches near the edges became sterile. The sterility was due to free sulphuric acid (pH 2·1–2·8) with the consequent release of toxic amounts of manganese and aluminium during the drying out of the peat. An additional toxic factor was the high concentration of sodium sulphate which formed a crust on the peat surface. Remedial measures for present dead patches are flooding and leaching together with heavy dressings of lime.

Animal Health

220. Investigations were carried out by the nutritional section of the Animal Health Research Centre, Entebbe, on the variations of total calcium and inorganic phosphorus in the blood of Zebu cattle. The variations of these elements in the pasture throughout the different seasons were correlated, and investigations were extended to include factors which might cause variations. Studies were begun on the habits of Zebu cattle, and data were collected, particularly in regard to grazing habits and the various factors which influence them. This work is being continued to include investigation on the habits of indigenous cattle maintained under different systems of management found in the Protectorate.

221. Investigation continued on the comparative productivity of three herds of cattle indigenous to Uganda, namely, the small East African Zebu, the Ankole Longhorn, and the " Nganda " breed, under parallel environmental and management conditions at the Experiment Stations at Entebbe and Mbarara.

Forest Research

Timber

222. An experimental workshop was completed with a representative series of commercial timber milling and processing units: work was begun on the testing of local timbers. Experiments in natural and artificial regeneration of indigenous hardwoods were continued.

Forest enumerations

223. Work was continued on the evolution of statistically sound sampling methods for use under local conditions and the result of this work has been published and is being applied to all current enumeration surveys.

W. J. Eggeling and I. R. Dale, The Indigenous Trees of the Uganda Protectorate, pp i-xxx and 1-491, 58 half-tone illustrations from photographs of trees, 21 coloured plates of flowering and fruit branches, and 94 line drawings and map; Crown Agents for the Colonies, 4, Millbank, London, S.W.1, 42 shillings.

H. C. Dawkins, Experiments in Low Percentage Enumerations of Tropical High Forest, Emp. For. Rev., 1952, 30, 131-145.

ZANZIBAR

Theraptus Damage to Coconuts

224. Investigations into premature nutfall and gummosis of coconuts are being carried out by the Protectorate entomologist. In the laboratory, cross-breeding experiments indicated that the Coreid bug *Theraptus* from Zanzibar, Pemba and the mainland constitute one species. Studies of the life histories of this insect and associated ants continued and laboratory tests were made of various formulations of the newer insecticides. In the field, observations on the feeding behaviour of *Theraptus* showed a wider

range of host plants. In particular young mango fruits were much used by the insect. Certain parasites and predators of *Theraptus* were observed. An important development was the discovery that certain other insects, notably an ant (*Polyrhacis* sp.), a Lepidopteran larva and a weevil, also cause damage hitherto ascribed exclusively to *Theraptus*. The relative importance of these other pests is not yet known nor to what extent control measures applied to *Theraptus* will also deal with these other insects.

225. The only experimental control measure so far applied on a large scale was a double aerial spraying of 500 acres of coconut plantation. This was carried out by officers of the Colonial Insecticides Research Unit. A DDT in oil formulation was used and full scientific observations as well as costings were made. The results will not be apparent for some months yet. In other spraying and dusting experiments several thousands of palms were treated with various formulations of DDT and other insecticides.

226. Attention was also paid to the problem of effecting a return of *Oecophylla* ants to areas from which they had been driven by *Anoplolepis* and *Pheidole* ants. It is considered that natural biological control in this way is likely to be by far the cheapest and most effective means of controlling *Theraptus*. To this end, spraying experiments for the eradication of the non-useful ants were begun: the insecticide Dieldrex is proving very effective for this purpose. Banding experiments were also undertaken in order to protect young colonies of *Oecophylla* introduced, artificially or otherwise, into the crowns of the coconut palms.

Calf Mortality Survey

227. A survey of calf diseases and causes of death was carried out in Pemba. While East Coast Fever causes more losses of calves than all other diseases, the percentage of fatalities is much lower than was suspected. Under relatively healthy conditions deaths may be less than 10 per cent. The other 90 per cent. or more achieve valuable immunity to the disease. Experimental spraying and dipping of cattle continued in order to assess the value of tick control.

VI. REPORTS OF STANDING SUB-COMMITTEES

(a) *Cocoa Research Sub-Committee*

228. The Sub-Committee wish to record their appreciation of the services rendered by Mr. C. G. Eastwood who was obliged to relinquish the Chair on his appointment as Permanent Commissioner of Crown Lands. He has been succeeded by Mr. W. B. L. Monson.

229. The Sub-Committee held one meeting, in September, at which Mr. J. West, Director of the West African Cacao Research Institute, was present to discuss the annual programme of the Institute and the progress of experiments in the control of the mealybug vector of swollen shoot disease by systemic insecticides. Other branches of the Institute's work include the introduction and breeding of possible parasites of the mealybug, control of capsids by insecticides, soil fertility and agronomic experiments, and the improvement of cocoa selection and methods of fermentation.

230. The serious loss caused in West Africa by black pod disease was also considered by the Sub-Committee. Research on this disease has been carried out by Mr. C. A. Thorold, Plant Pathologist, who has found that the build-up of infection can be prevented by frequent and regular removal of black pods,

and that the incidence of the disease can be greatly reduced by spray applications of 1 per cent. Carbide Bordeaux Mixture. The discovery in Western Samoa of a single cocoa tree which is apparently resistant to black pod disease offers a further long-term possibility of success and, on the recommendation of the Sub-Committee, attempts are being made to obtain material from this tree for multiplication and distribution to Colonial cocoa growing territories.

231. The Sub-Committee has followed with interest the progress of the cocoa collecting expedition to Colombia, organised by the Imperial College of Tropical Agriculture in collaboration with the Colombian Government and the West African Cacao Research Institute. The expedition commenced in June, 1952, and will last about one year. Latest reports show that although considerable knowledge has been gained of the genera *Theobroma* and *Herrania* in the first area to be explored near the Brazilian and Venezuelan borders, no discovery has yet been made of varieties of *Theobroma cacao* which are likely to be of commercial value.

(b) *Soils Sub-Committee*

232. The Sub-Committee held one meeting in June. This was attended by Professor F. Hardy, Imperial College of Tropical Agriculture, whose progress report on the West Indian Soils Research Unit was considered by members. The difficulties caused by vacancies in the staff of the Unit led the Sub-Committee to discuss the wider question of the demand for, and supply of, soil workers, particularly for soil survey, and a small Working Party was subsequently convened to go into this question in detail. As a result of their recommendations, it has been decided to establish a Pool of Soil Surveyors, based on the Soil Survey of England and Wales at Rothamsted, whose members will be available on loan to Colonial territories for short periods.

233. Among other matters discussed by the Sub-Committee was the form of post-graduate training most suitable for Colonial Soil Science Research Students. During the year under review four such students have completed their training and have been assigned to posts with the Governments of Nigeria, North Borneo, and British Guiana, and with the West African Rice Research Station, Rokupr, Sierra Leone. A further student was sent to British Honduras to gain field experience with, and to assist, the Land-Use Survey.

(c) *Stored Products Research Sub-Committee*

234. One meeting was held by the Sub-Committee in May. Three meetings were held by the Sub-Committee's Working Party, which is responsible for advising on the scientific direction of the West African Stored Products Research Unit.

235. Funds have been provided by the contributing West African Governments and the Nigerian Produce Marketing Board to maintain the West African Stored Products Research Unit for a further period of three years. Much of the past year was devoted to continuation of the work on infestation of cocoa by *Lasioderma*. A newly recruited entomologist has been posted to Ibadan and is making a full-time study of the biology of the insect and the means by which cocoa becomes infested. Warehouse populations are being studied, and a trial to investigate changes in degree of infestation between Nigeria and the United Kingdom has been started. Dr. W. F. Jepson, Chairman of the Working Party, made an extensive tour of Nigeria and advised on lines of research and on the future organisation of the Unit. His visit was closely followed by that of Mr. D. W. Hall, the Colonial Liaison Officer at the Pest Infestation Laboratory, Department of Scientific and

Industrial Research. It has been decided to augment the control measures now in operation at Kano: the officer-in-charge of the Unit and the second entomologist are to be stationed there this year. Research into the biology of *Trogoderma,* methods of cross-infestation and bio-assay of various control measures is to be undertaken. An investigation has been started into the possibility of reducing with safety the dose of methyl bromide used in fumigation and into the effect on gas dissipation of the type of pyramid plinth.

236. The report of the West African Pest Infestation Survey, whose investigations in 1948-1950 led to the establishment of the present Unit, was published in 1952 by Her Majesty's Stationery Office as a Colonial Research Publication entitled " Insect Infestation of Stored Food Products in Nigeria ".

237. In addition to his visit to Nigeria, Mr. Hall has made a tour of other Colonial territories in West and Central Africa and has also visited Southern Rhodesia and the Union of South Africa. A considerable amount of his time has been devoted to work on food storage and infestation problems brought back from his tour of East Africa during the previous year ; as an example, he has made recommendations for the control of insects infesting haricot beans imported to the United Kingdom from East and Central Africa.

238. Experiments, based on a method developed by the Argentine Ministry of Agriculture, have been in progress for some time in Nyasaland, Tanganyika and Nigeria in the underground storage of grain for famine reserve. Preliminary reports indicate that, provided that suitable precautions are taken in constructing the pits, grain can be stored at very low cost and for long periods without deterioration and without danger of build-up of insect populations. The lessons learned from these experiments are being studied with a view to offering more detailed advice to Colonial Governments wishing to employ the method on a commercial scale.

239. At the request of the local Governments, Mr. T. A. Oxley of the Pest Infestation Laboratory, Department of Scientific and Industrial Research, visited Singapore, the Federation of Malaya and North Borneo to study and advise on methods of rice storage. Copies of a report on this subject, which he submitted to the Food and Agriculture Organisation, have been distributed to other interested Colonial Governments.

Colonial Insecticides, Fungicides and Herbicides Committee Sixth Annual Report (1952-1953)

Commonwealth Institute of Entomology,
British Museum (Natural History),
London, S.W.7.
22nd July, 1953.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Insecticides, Fungicides and Herbicides Committee for the year 1952–53.

I am,

Sir,

Your obedient Servant,

(Sgd.) W. J. HALL,
(Chairman).

Captain The Right Honourable Oliver Lyttelton, D.S.O., M.C., M.P.,

Secretary of State for the Colonies.

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

Membership

DR. W. J. HALL, C.M.G., M.C., Director, Commonwealth Institute of Entomology (*Chairman*).

PROFESSOR G. E. BLACKMAN, Department of Agriculture, University of Oxford.

DR. J. CARMICHAEL, C.M.G., late Colonial Veterinary Service.

AIR COMMODORE K. D. G. COLLIER, C.B.E., Ministry of Supply.

DR. P. C. C. GARNHAM, Professor of Medical Photozoology, London School of Hygiene and Tropical Medicine.

MR. G. V. B. HERFORD, O.B.E., Pest Infestation Laboratory, Department of Scientific and Industrial Research.

DR. G. A. C. HERKLOTS, Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.

DR. H. G. H. KEARNS, Department of Agriculture and Horticulture, University of Bristol.

DR. R. LEWTHWAITE, O.B.E., Joint Secretary, Colonial Medical Research Committee.

DR. E. A. PERREN, Chemical Defence Experimental Establishment, Ministry of Supply.

DR. C. POTTER, Head of Insecticides Department, Rothamsted Experimental Station.

PROFESSOR J. W. MUNRO, C.B.E., Imperial College of Science and Technology.

MR. W. S. BATES, Secretary, Tsetse Fly and Trypanosomiasis Committee.

PROFESSOR SIR JOHN L. SIMONSEN, F.R.S.

DR. S. P. WILTSHIRE, Director, Commonwealth Mycological Institute.

MAJOR-GENERAL T. YOUNG, C.B., O.B.E., Director of Army Health, War Office.

Ex-Officio Members

The Secretary of State's Medical, Agricultural, Animal Health, and Forestry Advisers.

Mr. R. W. PIPER (*Secretary*).

Officer-in-Charge of Colonial Insecticide Research—MR. C. B. SYMES, O.B.E. (until 31st December, 1952), DR. R. A. E. GALLEY (from 1st January, 1953)

The terms of reference of the Committee are:—

(i) to advise the Secretary of State for the Colonies on any problems concerning the use of insecticides, fungicides and herbicides (including arboricides and defoliants) which may be referred to the Committee by him:

(ii) to examine and advise upon research and experimental projects relating to insecticides, fungicides and herbicides which may be referred to it:

(iii) to initiate research in insecticides, fungicides and herbicides, which is approved as desirable by the Secretary of State, and to carry out experimental field work with these materials:

(iv) to co-ordinate agricultural, medical and veterinary interests in the use of insecticides, fungicides and herbicides in the Colonies, and to ensure that the latest scientific information on these materials is available to those concerned with their use in the Colonies.

The work of the Committee is assisted by four sub-committees whose membership is as follows:—

SUB-COMMITTEE ON INSECT VECTORS OF DISEASE

DR. P. C. C. GARNHAM, Reader in Parasitology, London School of Hygiene and Tropical Medicine (*Chairman*).

MAJOR-GENERAL SIR GORDON COVELL, C.I.E., Ministry of Health Malaria Research Laboratory, Horton Hospital, Epsom.

DR. W. J. HALL, C.M.G., M.C., Director, Commonwealth Institute of Entomology.

MR. G. H. E. HOPKINS, O.B.E., Zoological Museum, Tring, Herts.

DR. R. LEWTHWAITE, O.B.E., Joint Secretary, Colonial Medical Research Committee.

PROFESSOR G. MACDONALD Director, Ross Institute of Tropical Hygiene.

SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., Chief Medical Officer, Colonial Office.

Mr. E. A. C. BENTS (*Secretary*).

AIRCRAFT TRIALS SUB-COMMITTEE

AIR COMMODORE K. D. G. COLLIER, C.B.E., Ministry of Supply (*Chairman*).

MR. W. J. BIGG, C.M.G., Colonial Office.

MR. A. E. H. HIGGINS, Imperial College of Science and Technology, Field Station, Silwood Park.

DR. H. G. H. KEARNS, Department of Agriculture and Horticulture, University of Bristol.

DR. A. B. P. PAGE, Imperial College of Science and Technology, Field Station, Silwood Park.

DR. C. POTTER, Rothamsted Experimental Station.

DR. R. FORD TREDERE, Ross Institute of Tropical Hygiene.

DR. E. K. WOODFORD, A.R.C. Unit of Experimental Agronomy, University of Oxford.

MR. E. A. C. BENTS (*Secretary*).

FUNGICIDES SUB-COMMITTEE

DR. S. P. WILTSHIRE, Commonwealth Mycological Institute (*Chairman*).

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Agricultural Adviser to the Secretary of State.

DR. G. A. C. HERKLOTS, Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.

MR. R. LEACH, School of Agriculture, Cambridge.

DR. G. WATTS PADWICK, Imperial Chemical Industries Ltd.

DR. A. F. POSNETTE, East Malling Research Station.

MR. G. SAMUEL, Agricultural Research Council.

MR. E. A. C. BENTS (*Secretary*).

HERBICIDES AND ARBORICIDES SUB-COMMITTEE

DR. G. A. C. HERKLOTS, Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research (*Chairman*).

PROFESSOR G. E. BLACKMAN, Department of Agriculture, University of Oxford.

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Agricultural Adviser to the Secretary of State.

MR. F. S. COLLIER, C.B.E., Forestry Adviser to the Secretary of State.

DR. E. K. WOODFORD, A.R.C. Unit of Experimental Agronomy, University of Oxford.

MR. E. A. C. BENTS (*Secretary*).

The Officer-in-Charge, Colonial Insecticides Research, and the Secretary of the Committee, are ex-officio members of all sub-committees.

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

SIXTH ANNUAL REPORT

CONTENTS

PART III—*continued*

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

SIXTH ANNUAL REPORT

PART 1. GENERAL

1. *Membership of the Committee.* Dr. D. L. Gunn resigned from the Committee and relinquished his membership of the Aircraft Trials Sub-Committee in April, 1952, on his appointment as Director of the International Red Locust Control Service. He was succeeded on the Committee by Mr. G. V. B. Herford, Director, Pest Infestation Laboratory.

Dr. H. Martin resigned from the Committee in consequence of his appointment to the University of Western Ontario, Canada.

Dr. H. G. H. Kearns, Department of Agriculture and Horticulture, University of Bristol, was appointed to the main Committee and to the Aircraft Trials Sub-Committee.

Due to his impending return to New Zealand, Dr. E. A. Denz resigned from the Committee in December, 1952, and was succeeded by Dr. C. Potter, Head of the Insecticides Department, Rothamsted Experimental Station.

Mr. A. E. H. Higgins, Imperial College Field Station, Silwood Park, was in August, 1952, appointed a member of the Aircraft Trials Sub-Committee.

Mr. C. B. Symes resigned from his appointment as Officer-in-Charge of Colonial Insecticides Research in December, 1952. Dr. R. A. E. Galley was appointed Officer-in-Charge, Colonial Insecticides Research, and became ex-officio a member of the main Committee and all Sub-Committees.

The Committee wish to record their appreciation of the valuable services rendered by Dr. Denz, Dr. Gunn, Dr. Martin, and Mr. Symes.

Mr. R. W. Piper was appointed Secretary of the Committee in August, 1952, in succession to Mr. K. G. Ashton who assumed another appointment in the Colonial Office.

Mr. E. A. C. Bents was appointed secretary of the Sub-Committee in November, 1952, in succession to Mr. D. Bishop who assumed other work in the Colonial Office.

2. *Meetings.* The Committee held two meetings during the period under review.

3. *Sub-Committees.* (*a*) The Insect Vectors of Disease Sub-Committee held three meetings during the year.

(*b*) The Aircraft Trials Sub-Committee met twice during the year.

(*c*) The Fungicides Sub-Committee met once during the year.

(*d*) The Herbicides and Arboricides Sub-Committee met once during the period under review.

PART II. SUMMARY OF ACTIVITIES

4. Work has continued in the United Kingdom at Porton, Silwood Park and Rothamsted on the more fundamental aspects of the use of insecticide and in East Africa, Mauritius and Malaya on experimental field applications.

5. At Porton the team of two entomologists, a chemist and two junior assistants continued studies on the behaviour of insecticide crystals on the mud used for native houses in many parts of the tropics in an attempt to explain the relatively poor effect of DDT against certain species of mosquito (notably *Anopheles gambiae*) (paragraph 11). They also continued the

work on insecticidal coatings (para. 22) and carried out a preliminary wind tunnel study of the deposition of small particles on various obstacles including tsetse flies in low wind speeds (16–20).

6. The Team in East Africa, consisting of four entomologists, a physicist, a chemist, a senior executive officer and nine European assistants, continued field and laboratory studies on aircraft applications of chemicals to tsetse-fly bush of various kinds (36–39), and to coconut plantations (44) (for control of a plant bug). One of the entomologists was engaged on studies for insecticidal control of three main agricultural pests.

7. In Mauritius the experimental malaria eradication scheme was terminated: malaria transmission virtually ceased as the result of the elimination of one mosquito-vector (*A. funestus*) and a reduction in houses of the second (*A. gambiae*). The latter is still abundant in cattle sheds and outside harbourages, however, and studies are continuing to determine why it escaped the house treatment with DDT. With the exception of the entomologist, the scientific team is being withdrawn and most of its members are being posted for work in East Africa (47–50).

8. Work continued on arboricides and herbicides in East Africa. A member of the A.R.C. Unit of Experimental Agronomy at Oxford visited East Africa and Nyasaland to plan and co-operate in field studies. Experiments in defoliation of certain types of tsetse-fly bush produced very promising results (para. 37).

9. The experimental trial of insecticides for the control of rural malaria in Malaya was terminated. Results from both DDT and BHC were promising (para. 51).

10. The work of the scientific staff here and overseas continued to attract many visitors from official and other scientific institutions throughout the world.

PART III. REVIEW OF RESEARCH WORK

Colonial Insecticide Research Unit, Porton (England)

(Dr. A. B. Hadaway in charge.)

11. *Sorption of insecticides by certain types of dried mud.* (A. B. Hadaway and F. Barlow) (28).*

(*a*) Stability of pp' DDT adsorbed on dried mud blocks.

Rapid loss of deposits of DDT particles from the surface of dried red-mud blocks, reported previously, showed that this was due to adsorption on to the mud particles in the first 2mm. of mud. There was no decomposition of the DDT.

It is now known that over a period of 12 months the DDT has moved still further from the surface, most of it being within 5 mm., but some reaching one centimetre from the surface.

(*b*) In a further study of this behaviour, red lateritic soils from Uganda, Nigeria and Jamaica were the most active, sorbing DDT in 2-3 days ; grey and brown soils from India and Liberia requiring 1 to 3 weeks ; and several English soils showing little sorption during 2 months.

(*c*) Visual observation is the best indication of the loss of surface deposit but absorption of carbon tetrachloride is closely correlated with degree of insecticide sorption at least in highly active soils.

* Figures in brackets refer to corresponding paragraphs of the 1951–52 Report.

(*d*) Sorption can be checked to a very considerable degree experimentally by the addition to the DDT formulation of 1·5 per cent. of ordinary size. But the size also makes the insecticide less available to alighting insects by sticking it down. Pre-spraying with phosphates, as recommended by some authorities in India, did not check sorption appreciably but pre-spraying with a whitewash helped.

12. *The behaviour of different species of mosquito in contact with insecticide deposits* (29–32). Activation of mosquitoes to flight after contact with an insecticide deposit is not necessarily due to the toxicity of the insecticide. *Anopheles stephensi* became activated on both toxic and non-toxic deposits. Total molecular structure of the insecticide and its lipoid solubility both appear to play important parts in penetration to or through the insect cuticle and hence in activation to flight and in toxic effect.

13. *Anopheles gambiae.* Specimens bred from eggs sent from Mauritius and East Africa have shown no definite resistance to or tolerance of DDT. More work on this is planned.

14. *Mosquito larvicides.* Laboratory tests indicated that films of certain oils containing high spreading material were not toxic to *Anopheles stephensi* larvae until they reached a thickness of about 7 microns. One micron films became toxic with the addition of 2 or 3 per cent. of DDT. Addition of 1 per cent. pyrolan, dimetan or allethrin to the films of oil did not increase toxicity, but 1 per cent. of Prolan, gamma BHC, dieldrin and Aldrin did.

15. *The effect of the solvent on toxicities of insecticide solutions.* Results obtained so far may be summarised as follows:—The toxicity of an insecticide in solution to a given insect species varies considerably according to the solvent. In a series of hydrocarbon solvents the effectiveness of an insecticide decreased as the boiling point and viscosity of the solvent increased. The extent to which a good carrier solvent such as n-hexadecane increases the effectiveness of an insecticide against mosquitoes (*Aedes aegypti*) varies from one insecticide to another. For example, the performance of DDT or prolan is improved much more than is that of dieldrin, endrin or malathon. The size and shape of the insecticide molecule may be a limiting factor in determining its rate of penetration. In contrast, the toxicity of dieldrin to houseflies is increased to a much greater extent than it is to mosquitoes. It may be significant that dieldrin is comparatively more toxic to houseflies than to mosquitoes.

16. *Studies on the Deposition of Oil Drops.* Preliminary experiments were carried out in a horizontal wind tunnel to investigate the deposition of air-borne oil droplets of different sizes on obstacles of different sizes and shapes, and on tsetse flies at rest on these obstacles. In this way, it was hoped to obtain information on the distribution of drops reaching the bush from sprays applied from the ground or the air, to indicate the optimum drop size range for deposition on tsetse flies wherever they may be resting on branches and leaves, and to indicate the optimum size range giving maximum coverage of branches and leaves for residual action.

17. Qualitative observations were made, at wind speeds of 1, 2 and 4 m.p.h., on the sites of deposition of dyed drops up to 60 microns in diameter on cylinders from 0·67 to 0·05 cm. in diameter, on discs from 2 to 7 cm. in diameter, and on dead tsetse flies mounted in the typical resting attitude in various positions on these obstacles. Obstacles of each size were placed either horizontally or vertically in the air stream.

18. At 1 m.p.h. deposition was mainly by sedimentation: drops collected only on the upper half of horizontal cylinders and on the upper surface of

horizontal discs. At this wind speed there was very little deposition on vertical cylinders, and this occurred on smaller cylinders by impaction symmetrically about the mid-windward line only with the large drops. Twenty micron drops were not deposited on any of the vertical cylinders. At higher wind speeds deposition by sedimentation was superseded by deposition by impaction, and the efficiency of a cylinder in collecting drops by impaction increased as the wind speed increased. At a given drop size and cylinder diameter the angle covered about the mid-windward line increased as the wind speed increased. At a given wind speed and drop size the angle covered increased as the cylinder diameter decreased. At a given wind speed and cylinder diameter the angle covered increased as the drop size increased. At 4 m.p.h. there was some impaction on the leeward side of the largest vertical cylinders and discs.

19. Observations showed that deposition of air-borne drops occurred more readily on tsetse flies at rest on the obstacles than on the obstacles themselves. Thus, at all three wind speeds, flies collected some 20 micron drops wherever they were resting on the larger vertical cylinders although the cylinders remained completely free from deposit.

20. At the low wind speed of 1 m.p.h. flies on the upper half of horizontal cylinders and on the upper surfaces of discs received an even deposit of drops on all upper surfaces of the body by direct sedimentation. On the other hand, flies on the lower half of these cylinders or on the under surface of discs were protected by the obstacle to a degree dependent on the obstacle size and the terminal velocity of the drops. At higher wind speeds the change from deposition by sedimentation to deposition by impaction was shown by a change in the distribution of drops from the upper surface of flies to their windward sides and by a decrease in the protection afforded by the obstacle.

21. Flies at rest on the windward side of verticle cylinders collected drops by impaction even when there was no deposition on the cylinders. At 1 m.p.h., 60 micron drops impacting on the side of a fly were generally distributed over the head, thorax, abdomen and appendages, but as the drop size decreased they tended to be selectively collected on the appendages (legs, costal margin of wings, proboscis and antennae). Impaction of 20 micron drops on the head and thorax was negligible. The efficiency of collection by the appendages decreased as the drop size decreased and drops smaller than 10 microns were not collected on the appendages.

22. As the wind speed increased, however, the minimum size of drops impacting on the appendages increased. Thus, at 2 m.p.h. 10 micron drops impacted on the legs and costal margin of the wings. At 4 m.p.h. 20 micron drops impacted on all parts of the body.

23. Deposition on flies frequently occurred by sedimentation in the " dead " space behind or in front of an obstacle, and the dosage obviously depended on the orientation of the fly. Deposition on a fly head upwards occurred on the front of the head and eyes, on the exposed anterior part of the thorax and on the anterior surfaces of the fore legs. The dosage on a fly at right angles to this was much greater because of the increased surface area given by the side of the head, thorax, abdomen and appendages.

24. It may be concluded that the optimum drop size range for deposition on tsetse flies at rest on the cylinders and discs used in these experiments at low wind speeds of up to 4 m.p.h. is from 10 to 30 microns. Drops in this size range, however, are not collected efficiently by the cylinders and discs, and larger drops are required for deposition on them.

25. *Spraying Installations on aircraft* (R. Hill) (Paras. 35–38).

(*a*) The S.A.5 spray boom installation was fitted to Anson I aircraft G-AIRX, and assessment trials were carried out successfully before the aircraft left for East Africa. The massmedian diameter of the spray drops was 50 microns. A description of the apparatus and full details of the trials were given in Porton Technical Paper No. 297.

(*b*) A slightly modified S.A. 5 spray boom installation was designed for fitment to the Colonial Office Avro XIX aircraft G-AKDV in East Africa.

(*c*) A relief valve to operate over a pressure range larger than that covered by the normal aircraft type of valve was designed to meet requirements in East Africa, and two such valves were despatched for fitment to the aircraft there.

(*d*) An exhaust smoke installation incorporating a nozzle designed by the makers of the Todd Insecticidal Fog Applicator was fitted to an Avro XIX aircraft and tested. The insecticide solution is pumped through a distributor, the head of which contains holes disposed radially about a central feed hole, into an atomiser. A proportion of the exhaust gas is diverted through tangential holes in the atomiser and breaks up the liquid issuing from the distributor head into drops which pass into the atmosphere with the remainder of the exhaust gas. The mass median diameter of the drops produced was 80 microns. A full description of the apparatus and details of the trials were reported in Porton Technical Paper No. 312.

26. Some observations of an analytical interest were made during these trials. Waxolene red was suitable as a tracer, and the Schechter-Haller method was suitable for the estimation of deposits from the sprays. Phenyl α-naphthylamine (PAN) was not suitable as a tracer in field work because of its instability on exposure to light and air. One of the requirements of the trials was to determine if any decomposition of DDT occurred during its brief contact with hot exhaust gas. A method was devised by which more than 2 per cent. decomposition of DDT could be detected and measured. It depended on a comparison of absorption curves developed in the Schechter-Haller procedure with samples of the spray liquid before and after passage through the installation. No decomposition of pure or technical DDT was found.

(*e*) A simple method to provide a constant rate of flow of insecticide solution from a tank is required in the operation of such equipment as Rotary Brushes. The device of a breather tube inserted to within half an inch of the bottom of an airtight tank was investigated. Static and airborne tests showed that this device was satisfactory for tanks of up to 100 gallons capacity and for rates of flow up to 35 gallons per minute.

27. *Semi-permanent coatings* (P. Bracey) (20–27).

(*a*) Pyrethrum + piperonyl butoxide, 10 and 20 per cent. allethrin, 5 per cent. gamma BHC, 20 per cent. dieldrin, and a heavy bloom of DDT were tested in urea formaldehyde resins, applied to copper mesh mosquito netting against the biting urge of tsetse flies (*Glossina palpalis*). Only the first prevented probing and feeding on the human arm.

(*b*) Insecticidal coatings were applied experimentally by existing industrial techniques to packing paper and book-binding cloth. "Blooming" and insecticidal potency was markedly reduced however with the curing temperatures used, by the harder coatings containing 5 per cent. to 10 per cent. DDT.

(*c*) Coatings containing 2 per cent (on the resin solids) of N-trichloromethyl-thio-tetrahydrophthalamide (SR406) in resins produced a "bloom" of crystals after surface stimulation. Coatings on glass after exposure to artificial rain were toxic to germinating spores of *Botrytis fabae*.

(*d*) Anti-fouling coatings containing DDT and a herbicide protected test wood surfaces immersed in water, and prevented algae and barnacle growth and attacks by *Limnoria* (Gribble).

(*e*) Coatings applied to surfaces in ships continued to show great promise. One coating containing 10 per cent. aldrin and subjected to weekly cleaning ceased to show fumigant toxicity only after 14 months in the tropics. Toxicity is influenced by hardness of coatings and this can be controlled.

Imperial College Field Station, Silwood Park (England)

28. The transport of DDT solutions in lanoline across the integument of blowflies was investigated. The process may be similar in certain respects to the penetration of oily spray droplets. The rate of entry varies at structurally different parts of the integument. It is, for example, approximately twice as fast at the antennae as it is at the wings. It was shown that sclerotin is not a barrier to penetration, since entry into adjacent regions of sclerotised and unsclerotised cuticle took place at the same rate. The rate of entry was compared at 25° C. and 16° C., and was at least three times as fast at the higher temperature. After 6 hours the rate of entry at 25° C. falls off to a steady value, which may indicate the saturation of a system other than the wax layer of the epicuticle, since this layer becomes saturated at the site of treatment within a few minutes. Though the rates of entry of DDT solutions are of the same order at the antennae and genae, the toxicity of the antennal treatments is consistently greater. This difference in toxicity is possibly correlated with the distribution of sensory nerves. The rate of penetration decreases after death.

29. Studies of the contamination of flies exposed to particulate deposits were continued during the past year. The rate of uptake of dust particles by active blowflies diminishes rapidly during the first seconds of exposure, e.g. by 35 per cent. in the first second and by 90 per cent. in fifteen seconds on a deposit of 20 micron particles at 25 mgm/sq. ft. The ventral tarsal spines and receptors take up about fifteen times as much material as the pulvilli, which were previously thought to be the most important sites of accumulation. The delicate frontal membranes of chemoreceptors are notable sites of uptake, but the intersegmental membranes are defended from particles by spines which themselves become heavily contaminated. Cleaning movements play an important part by transferring particles in constant proportions from the tarsal spines to less exposed but in some cases more vulnerable regions of the body.

30. The processes by which contaminated flies can discard particles were studied in some detail. Small quantities of particles can be retained for very long periods.

31. A study of the activation of tsetse flies by olfactory stimulation was started.

Long Ashton Research Station (England)

32. *Adhesion of Fungicidal Spray Deposits to Foliage.* Work was begun by Mr. E. Somers (under the direction of Dr. W. D. E. Thomas) at the Long Ashton Research Station on the possibility of increasing the persistence of copper fungicide deposits on foliage under conditions of heavy rainfall. Laboratory apparatus was designed and constructed (*a*) to give a reproducible spray deposit and (*b*) to simulate the leaching effect of rain. Using this apparatus, over fifty different stickers available on the market were tested for their effect on the adherence of cupric oxide deposits on cellulose acetate films, after subjection to increasing amounts of artificial rain. The retention of the deposit was determined by precision weighing and colorimetric analysis. As a result of this work some six materials were selected for further study, which will include tests on field crops and the biological assay of the fungicidal activities of the deposits.

Rothampsted Experimental Station (England) (44–53)

33. The rate of loss of insecticidal effect of DDT deposits on living foliage in the glass-house was studied under various conditions, glass plates sprayed with DDT, exposed alongside the plants, being used as a standard of comparison. After 37 days at 10°–20° C., about one third of the DDT had disappeared, as shown by chemical and biological assay, only a small part of this loss being accountable to growth of the leaves. After 14 days at air temperatures of 15°–35°, with strong sunlight which caused heating of the foliage above the air temperature, losses amounted to about half of the deposit originally present. In each case, losses from glass plates were greater than those from leaves. The rate of loss was not proportional to the density of the deposit of DDT, but was relatively greater for the lower deposit densities. The biological activity fell off rather less rapidly, on the average, than the amount of DDT, possibly because the small crystals formed by evaporation of the original crystals of DDT were more toxic. These facts could all be accounted for by the hypothesis that under the conditions of the experiment, and after correcting for leaf growth, the only significant cause of loss of DDT was volatilization.

34. Earlier work had shown that DDT was toxic to *Tribolium castaneum* when it was dissolved in wax and spread on glass plates in a film 0·5 micron thick. The above experiments therefore, did not show whether or not the DDT had dissolved in the wax layer of the leaf. It was found that DDT dissolved in wax was much more readily decomposed by ultra-violet radiation of 2537 AU from a mercury vapour lamp than was an equivalent deposit of DDT in crystalline form. By spraying wax-coated glass plates with DDT suspensions, storing for various periods at either 18° C. or 43° C., exposing some of the plates to ultra-violet radiation, then analysing both exposed and unexposed plates for DDT, it was found that not more than 10 per cent. of the DDT could be dissolving in the wax. Presumably, the wax immediately below each crystal becomes saturated, but diffusion in the plane of the film is too slow to permit solution of more than a small proportion of the DDT.

35. Microscopical examination of the crystalline deposits had proved uninformative because the thickness of the crystals is close to the limit of resolution of the optical microscope. Preparation of the specimens for electron microscopy involved too much interference with the deposits to give reliable information. It was found that use of dark-ground illumination with an oil-immersion lens showed up the crystals clearly, and made it

possible to distinguish them from the "casts" formed round them from dried wetting-agent. Using this method, an investigation was started of the types of crystalline deposit obtained from various formulations of the emulsion type. It was found that a xylene emulsion crystallized in a few hours, on glass or on wax surfaces, and the rate of evaporation of the deposits so produced was almost the same as that of deposits from crystalline suspensions of DDT, though there were some differences in the rate of change of toxicity to tribolium with ageing. This was found to be the case on both glass plates and dock-leaves.

Colonial Insecticide Research Unit: East Africa (54–80)

36. *Experiments against tsetse flies* (K. Hocking and staff (54–66)).

(1) *Aircraft spraying.*

(i) The situation at Kikore. Clearing operations on an extensive scale were carried out in the vicinity of the old experimental blocks by the Kondoa District Development Authority. This upset normal fly populations considerably and eliminated a block of bush that had been used as a control for the Atta Island experiment (55). It is not now possible to say whether or not the nil catches over six months in the experimental block were a true indication of the position. All that can be said is that eradication was very nearly if not quite achieved.

(ii) Kikore blocks. It appeared from routine catches that not only was there no recovery of fly in the experimental blocks, but numbers continued to decrease.

(iii) Field experiments at Urambo. At the invitation of the Overseas Food Corporation an experiment was carried out at Urambo, situated in the heart of the great western Tanganyika *morsitans* belt. Within an area of about 280 square miles all the land suitable for agriculture was cleared to form 25 farms of about 4,000 acres each. Heavy "Miombo" bush along the drainage lines between these farms was left uncleared and contained a tsetse population of approximately 120 old males per 10,000 yards. Bush on the outskirts of this farming area, which was separated by clearings from the drainage lines, also contained dense fly. The aim was to eliminate the fly from the drainage lines through the farming area, and this involved treatment by aircraft of two blocks of bush of about 5,000 acres and 10,000 acres respectively. The smaller area was sprayed with a 5 per cent. oil solution of BHC S215 (26 per cent. gamma) in equal parts of Shell Power Kerosene and Diesoline at a dosage of 0·25 gallons per acre. The larger area was sprayed with a 10 per cent. DDT solution in a similar solvent at the same dosage. Particle size was 70-80 microns mass median diameter. Seven applications were intended over a period of 12 weeks (=2 pupal periods). But accidents to both aircraft, fortunately with no loss of life, upset plans seriously and only five applications and a part of a sixth were possible over between 13 and 14 weeks. Reduction of fly was not satisfactory, though it apparently came down to almost nil after the third application. The experiment was virtually ruined by (i) inadequate separation of the treated block from the main body of surrounding infested bush, (ii) much movement of people and bicycles through the area, (iii) accidents to both aircraft which upset the time-table so seriously.

37. *Defoliation experiments.* The Unit co-operated with E.A.T.T.R.O. and the A.R.C. Unit of Experimental Agronomy, Oxford, in an application of 2.4.5.-T in oil to bush infested with tsetse (*G. palpalis* and *G. pallidipes*) on a small wooded peninsular in Kavirondo, Kenya. Three applications were made at intervals of about six weeks. Dosage was about 1·2 gallons per acre in each application but concentration was varied (37 per cent., 18·5 per cent. and 10 per cent.). The solution was applied as a fine spray with mass median diameter of 150 microns. Results were very promising.

A second and smaller experiment was carried out on a strip of bush in the Lambwre Valley (Kenya) with similar very promising results.

38. *Insecticides.* Observations were made upon loss of solutions by evaporation in airspraying, and upon the influence of fly movement upon the results of airspraying.

39. Airspraying at Maruzi in Uganda. In co-operation with the Uganda Government an experiment was begun against tsetse (*G. morsitans* and *G. pallidipes*) in thicket typical of much tsetse bush in East Africa, but unlike the bush encountered in previous experiments. The area selected for experiment is a block of about 40 square miles, contiguous with a much larger area, in which fly concentrations to be treated cover about 16 square miles. Seven applications of 10 per cent. DDT solution in oil are being made at about 12 day intervals. The results of the first three applications were satisfactory.

40. *Experiments with sprayed cattle.*—An experiment was conducted to ascertain the effect on fly, in a small block of bush, of grazing cattle sprayed with a solution of DDT. The reduction of *G. swynnertoni* was 92 per cent. and of *G. morsitans* 99·5 per cent.

41. *Experiments against mosquitoes* (K. Hocking and staff). Observations continued in the experimental huts at Taveta.

42. *"Barrier" house spraying for the protection of villages* (H. C. M. Parr).

A small experiment was designed to watch the effect upon the incidence of malaria of a barrier of houses sprayed with dieldrin between breeding grounds and a village. Observations on mosquitoes and malaria incidence have begun.

43. *Agricultural Research.* The entomologist (Mr. Walker) attached to the Agricultural Laboratories in Kenya continued his studies on maize stalk borer, chafer-grub of cereals and Red Scale of citrus. Laboratory studies were supported by field experiments.

Experimental aircraft applications for the control of agricultural crops.

44. *Coconuts.* A coreid bug (*Theraptus* sp) is a serious pest on coconuts in Zanzibar and on the East African coast. At the invitation of the Zanzibar authorities an experiment was carried out in which 500 acres of coconuts infested with this bug was sprayed from the air with a 9·2 per cent. solution of DDT in oil. Two applications were given, 16 days apart, each at a dosage of 0·25 gallons per acre. Particle size was 70–80 microns mean mass diameter, and deposits in the crowns of the palms where the bugs are found was 22 per cent. of the nominal dosage. Early results were very promising: a final assessment is awaited.

45. *Beans.* A 500 acre plot of beans on an estate near Arusha heavily infested with larvae of the American bollworm (*Heliothis armigera*) was

rapidly being destroyed. The saving of 142 acres of this seemed feasible if an effective chemical could be applied at once. An aircraft was therefore employed to apply a DDT emulsion at a concentration of about 1·5 per cent. DDT and at a dosage of about 2½ gallons per acre with an average particle size of 150 microns. The results were satisfactory, the total cost was 11s. per acre.

46. *Chemical work* (J. Robinson). Routine work included the estimation of all chemicals on arrival, and before use, and the analysis of large numbers of deposits and samples from the experiments and studies on tsetses and tsetse bush, mosquitoes, coconuts, etc. Analyses were also made for the Government of Uganda, the Malariologist East Africa, the Scott Agricultural Laboratory and the Government Chemist. Special studies were made of methods of analysis for dieldrin and for mixtures of DDT and BHC and more work was done on the determination of decomposition of DDT in smoke produced from aircraft exhaust apparatus. A special investigation of BHC on maize seed treated with BHC dust was conducted for the Department of Agriculture, Kenya, and for the Director of Medical Service, Uganda, of DDT in Nile water treated for the elimination of *Simulium*.

Malaria Eradication, in Mauritius

(Dr. M. A. C. Dowling and staff (84–88).)

47. The Malaria eradication experiment was terminated. Malaria transmission had been brought to nil in spite of the persistence of considerable numbers of *Anopheles gambiae*.

48. The behaviour of *A. gambiae* warrants further study and arrangements were made for an entomologist to remain in Mauritius for this purpose. He is to devote his time to a study of the ecology and habits of *A. gambiae* with a view to explaining the reason for its escape from the DDT house treatment that eradicated *A. funestus*. These studies will be linked up with others projected for East Africa which are designed to determine whether or not *A. gambiae* shows resistance to DDT or BHC, and whether or not it exists as a zoophilic race or variety.

49. The entomologist, Mr. J. G. Halcrow, organised various routine searches in and out of houses in his studies of *A. gambiae* habits and populations. He found appreciable numbers of fed females in sugar cane, grass and in rock crevices.

50. Mosquitoes in ships arriving in Mauritius. The entomologist searched 215 ships arriving at Port Louis, and found only 12 with mosquitoes, all of which were *Culex fatigans*.

Malaya (81–83).

51. *Malaria control in rural areas.* Dr. Wilson and Dr. Edeson, the Malaria Research Officers of the Institute for Medical Research, Kuala Lumpur, completed at the end of 1952 the third and final year of the field experiment in malaria control in rural areas, in which, in four valleys, the effect of residual insecticides was compared with that of weekly suppressive proguanil. During the first two years the investigations were financed equally by Colonial Welfare and Development research funds and by the Government of the Federation of Malaya; during the third year, by the latter alone.

52. Parasite- and spleen-rates of children examined at periodic surveys have fallen in all areas, though much more rapidly and to a greater extent in the protected areas. These rates are summarised below :—

Parasite- and spleen-rates of children 12 years and under examined at surveys

Area	Number examined (smallest–largest)	Parasite-rate per cent.						
		1949		1950		1951		1952
		1st	2nd	3rd*	4th	5th	6th	7th
DDT	378–529	49	33	16	12	5	4	6
BHC	138–183	32	38	17	12	12	3	6
Proguanil	288–529	37	25	5	3	1	1	2
Comparison ...	273–354	28	24	17	24	18	9	10

* Control work started about 4 months before this 3rd survey.

Area	Number examined (smallest–largest)	Spleen-rate per cent.						
		1949		1950		1951		1952
		1st	2nd	3rd*	4th	5th	6th	7th
DDT	378–529	66	64	45	36	23	17	19
BHC	138–183	60	59	45	48	30	26	21
Proguanil	288–529	59	53	34	20	15	15	13
Comparison ...	273–354	54	54	49	51	34	40	32

* Control work started about 4 months before this 3rd survey.

53. The slight rise in parasite-rates in the DDT and BHC sprayed areas shown in 1952 may reflect continued transmission of malaria despite control, but is thought to be due, at least in part, to movement of population into the protected areas from outside. Although weekly suppressive proguanil gave slightly better results than the residual insecticides, the regular distribution of any drug to a scattered rural population is difficult to organise, and one cannot hope to supervise the taking of the required dose. House spraying with DDT—or one of the newer residual insecticides—is therefore considered to offer the best prospects for the control of malaria in the rural areas of Malaya. Where the vector of malaria is a mosquito less suspectible to insecticides than *A. maculatus*, as several of them have proved to be, then more frequent spraying may be necessary to obtain satisfactory results. Whatever the vector may be, however, eradication either of the mosquito or of malaria by house spraying alone is not to be expected. This means that spraying programmes, once started, must be continued indefinitely. A full report of this experiment in malaria control is being prepared.

54. *Effect of residual insecticides on Malayan mosquitoes.* The Entomologists of the Institute, Mr. Reid and Mr. Wharton, have made further tests of residual insecticides in window-trap huts. Dieldrin at 40 mg. per square

foot applied as a wettable powder remained effective (i.e. 24 hour mortality not below 50 per cent.) for 4 months against *A. sundaicus*; this compares with last year's results of three months for DDT at 200 mg. and two months for BHC at 40 mg. gamma isomer per square foot. This dose of Dieldrin gave kills of 80–100 per cent. against *Culex fatigans* for about two months, after which the kill dropped rapidly to well below 50 per cent. This is a much better result than can be obtained with either DDT or BHC against *C. fatigans*; DDT kills very few, while BHC, though highly effective for the first week or so, kills less than 50 per cent. by the third to sixth week after application. Dieldrin was also tested against *A. maculatus*. A dose of 40 mg. was still giving a kill of over 90 per cent. in the third month, after which the numbers of adult *A. maculatus* became too low to continue the observations. With a dose of 10 mg. the mortality had fallen to 50 per cent. in the second month, and was only about 15 per cent. during the third month. These results were no better than those obtained with BHC in 1951; further experiments with dieldrin are planned.

55. Experiments with window-trap huts were started in 1948, and reports have been published from time to time. Results to date suggest the following broad conclusions regarding the effectiveness of residual insecticides against various species of mosquitoes in Malaya:—

(i) *Anopheles maculatus*, the principal vector of malaria, is more readily killed than most other Malayan species except perhaps *A. umbrosus*.

(ii) Doses of DDT and BHC that remain effective for nearly six months against *maculatus* last only about half that time against *A. sundaicus*; probably the same is true for *A. barbirostris* and species of *Mansonia* (the vectors of Malayan filariasis).

(iii) *A. letifer* is not readily killed by DDT, and the various species of *Culex*, especially *C. fatigans* are hardly affected.

(iv) DDT even when fresh does not kill more than 80–90 per cent. even of susceptible species, but BHC and dieldrin at first give a complete kill of all species. Against those species not readily killed by DDT, however, BHC rapidly loses its effect, and to a lesser extent the same is probably true of dieldrin.

Fungicides (89)

56. Dr. H. G. H. Kearns of Long Ashton Research Station visited Jamaica to advise on the control of Banana Leaf Spot. His recommendations included a series of field trials of fungicide substitutes for Bordeaux mixture and the testing of improved equipment. He is himself providing materials for some of this experimental work and is in close touch with the people concerned. Facilities are to be provided to enable him to maintain a general supervision of operations in Jamaica.

Herbicides and Arboricides (90–98)

57. *Control of regenerating bush.* In 1952 a four months' visit to East Africa was made by a member of the A.R.C. Unit of Experimental Agronomy, Oxford, to assess the results of experiments, laid down in the previous year, on the control of regenerating savannah-thorn bush at E.A.T.T.R.R.O., Shinyanga, and renegating *Isoberlinia* woodland at the C.I.R.U. field station, Kikore. The results showed that the overall spraying of regenerating trees and shrubs by the n-butyl esters of MCPA (2 methyl-4-chlorophenoxyacetic acid), 2,4-D (2 : 4 dichlorophenoxyacetic acid) and 2,4,5-T (2 : 4 : 5-trichlorophenoxyacetic acid) did not show promise as a

method of eradication, for although marked stunting of many species had taken place, few were killed. More elaborate spraying experiments were laid out at both Shinyanga and Kikore using improved equipment, including some eighty plots sprayed with power equipment mounted on a lorry. In addition, three experiments were started to try out the techniques of spraying (1) the stumps of species found in riverine thicket and (2) the bases of standing trees with and without the additional treatment of girdling. All the plots of regenerating bush that had been sprayed at Kikore and Shinyanga were reassessed early in 1953 and while a detailed examination of the results has not been completed it can be stated that with the existing herbicides overall spraying of the bush over a two-year period has failed to eradicate the bulk of the species, when at the time of treatment the regenerating shoots were 2–4 years old. In some species, however, the stunting was very severe and in a few the plants were killed.

58. The experiments in which stumps of felled trees or the bases of standing trees were sprayed with solutions of growth regulators in dieseline or kerosene are very encouraging. However, much more work is required before definite recommendations can be made.

59. *Control of Brachystegia/Isoberlinia bush.* During the visit at the request of the Department of Agriculture, three weeks were spent in Nyasaland initiating a comprehensive experiment on the effects of arboricides on species of *Brachystegia* and *Isoberlinia*: species which, as a result of the native practice of shifting cultivation, form unproductive woodland throughout much of the Northern Province.

60. *Defoliants.* In April, 1952, the first large scale testing of 2,4,5–T, as a defoliant, took place on the Waturi peninsula in the Kavirondo gulf of Lake Victoria with the objects of determining the direct effects on the vegetation and the resulting indirect effects on the tsetse population. Altogether, three applications of the ester in diesel oil were made by aeroplane at six-week intervals, the rates being 3·2, 1·6 and 1·1 lbs. of 2,4,5–T acid per acre. The applications were made by an Anson aircraft attached to C.I.R.U. and assessments were carried out by members of E.A.T.T.R.R.O.

61. The effects of the earlier defoliant applications on the Waturi peninsula were inspected and discussed with Mr. Johns of E.A.T.T.R.R.O., who had recorded the results. All broadleaved tree and bush species had been defoliated except for a species of *Trichilea* which was little affected. Many species, including *Euphorbia candelabrum* and *E. tirucalli* were dead a year after treatment, while many others had only partially refoliated. The vigorous growth of tall grasses in the rains following defoliation, combined with the dead twigs and scrub, had allowed a fire to destroy about half the vegetation, indicating that defoliation may prove useful as a means of encouraging bush destruction by allowing fierce burns to take place in vegetation which does not readily catch fire. The tsetse populations had not been greatly decreased by the defoliation alone, due to both the shelter provided by the *Trichilea* bushes and the lack of a really effective dry season following on the spraying.

PART IV. INSECTICIDES, FUNGICIDES AND HERBICIDES RESEARCH NOT UNDER THE AEGIS OF THE COMMITTEE (99–118)

62. The Committee wishes to draw attention to some of the research work being done in the Colonies without the assistance of the Committee. The following notes cover only those projects considered by colonial authorities to be of special interest. Much other work is going on.

Uganda

63. *Cotton Blackarm Disease.* Investigational work on the control of blackarm disease of cotton, in collaboration with Messrs. Imperial Chemical Industries Limited and Plant Protection Limited was successfully completed. Yield response to the control of the primary phase of the disease by seed disinfection was disappointing in small formal trials, presumably because of cross-interference between treated and untreated plots. But on a large scale there was a large response. The use of a copper disinfectant formulated as a seed-dressing makes unnecessary the use of mercurial compounds which are too dangerous to be put in the hands of unskilled labour.

64. Investigations continued in co-operation with the Senior Entomologist on the relationship between *Zanthomonas malvacearum* and *Lygus vosselleri.*

65. Small and large scale field trials carried on with the help of a Field Officer seconded by the Colonial Insecticide Research Unit, showed that substantial increases in cotton yields can be got by spraying weekly with 1 lb. technical DDT per acre in as little as 6 to 10 gallons of water, during the period of attack by *Lygus vosseleri* Popp.

66. The Entomologist found that the Root-Knot eelworm, *Meloidogyne* sp.. (*Heterodera marioni,* Cornu.), a serious pest of tobacco, was widespread and not confined to seedbed areas. Under the system of peasant agriculture prevalent in Uganda control measures may not be similar to those in more advanced countries, and trials are in progress to discover whether the seedbed infection is of primary importance or not.

Federation of Malaya

67. *Cacao.* Insect pests are proving among the more troublesome factors in field establishment of young cacao. The chafer *Apogonia* affecting cacao locally was found to include both *A. cribricollis* Burm. and *A. expeditionis* Rits ; a smaller species *A. aeneocuprea Msr.* caused relatively minor leaf injury. An unidentified *Tiphia* was found parasitising *Apogonia* larva, but exerted only negligible control. Control was effected by soil treatment with BHC and dusting the plant with DDT wettable powder. Investigations are in progress to control other pests of this crop including *Helopeltis theobromae* Miller. and two newly recorded pests, the leaf eating longicorn *Glenea funerula* Thoms. and the shoot boring weevil *Alcidodes* sp.

68. *Tea.* No outbreaks of blister blight (*Exobasidium vexans*) on low land tea were recorded during the year, and it appears unlikely that this disease will cause serious damage at low altitudes. Investigation with different fungicides and methods of application for control of blister blight showed that proprietary copper oxide and copper oxychloride preparations were more satisfactory than copper naphthenate and other organic fungicides ; that spraying must be carried out at not more than weekly intervals but that the strength of copper sprays might be reduced to 0·125 per cent., and application made with low-volume nozzle equipment at 10 to 20 gallons per acre. It was shown that in the absence of blister blight, copper sprays show promise of improving quality of local tea, in which copper uptake is normally low, by increase of the polyphenol oxidase enzyme action in the leaf.

British Guiana

69. *Padi Bug.* Insecticidal Experiments: Severely hampered by lack of substantial, widespread field populations of the insect. However, work on a few circumscribed patches of densely infested crop showed three dusts to

be highly effective, viz. BHC, derris and pyrethrum-piperonyl butoxide. Infested areas found were too small to permit proper estimation of application rates per acre. A field technique for applying dust to large areas of crop was evolved. In limited pilot tests wet spraying appeared to be most unpromising.

70. *Ecology.* A major alternate host plant was found, and bugs were discovered in fair numbers on a sand reef where weedy provision gardens had been established in a coconut grove.

71. *Economic Aspects.* Discovery of effective dusts has prompted the question " Is the usual amount of padi bug damage great enough to warrant the application of insecticidal control measures?".

72. Padi bug in British Guiana is commonly represented as a two-fold problem: (1) The growers claim that the bugs reduce the yield of whole-grain (i.e. saleable) padi per acre; they believe that the pest sucks the developing grain, causing " wind-rice " (Empty glumes) and/or incompletely filled kernals (" half-grain ", " be.-suck "), (2) The millers insist that padi bug is the main, if not the only cause of " black rice "—a complex of grain blemishes which results in down-grading of rice to the value of $180,000 once in every two years.

73. Investigations to date have yielded no indications that padi bug causes " wind-rice ", and one suspects that these field symptoms are due to causes other than padi bug. In regard to " black rice " there are strong indications that padi bugs may be only a minor and occasional cause of blemish.

Trinidad

74. *Mosquitoes and Malaria.* Three mud walled huts were erected, and Muirhead Thomson pattern exit traps, changed five times each night, were installed. The set up was elaborate. The traps were changed by a technician and the watchman, and mortality in the traps after removal and the day counts of dead on floor, were made by another technician. The bait was human. One hut served as control, one was sprayed with water-suspension DDT at 100-125 mg. *para-para* and the other was sprayed with BHC at 10-12 mg. gamma-isomer (in water) per square foot. The DDT was effective for five months, the gammexane for less than two months. Whilst gammexane was fresh it showed an interesting repellance-to-entrance effect not seen with DDT. The effect operated outside the hut, presumably by odour. Immediate death (= dead on floor) was much higher with DDT than with BHC, but the percentage of entrants living to reach the traps was much the same with both insecticides. Mortality in the trap catches was higher with DDT than with BHC during the first day, but evened up during the second.

Kenya

75. *Relapsing Fever.* The efficiency of different formulations of gammexane against *O. moubata* was studied. The most efficient preparation to date was found to be 0·5 per cent. wettable powder in water.

76. *Yellow Fever.* A study of the bionomics and control of *A. aegypti* by residual spraying was made at two villages at the Coast. The results were remarkable inasmuch as two years after the original spraying at Mambrui with DDT, no *Aedes aegypti* had reappeared in the houses, although they were found to be breeding in tree holes outside the village. The investigations into the bionomics of *Aedes aegypti* are continuing.

Northern Rhodesia

77. *Tick Control.* The services of Professor J. G. Matthysse of Cornell University were obtained under the E.C.A. programme, and, with his assistance, research was conducted on various insecticides, with particular regard to the comparative economics and efficiency of their use by different methods of application, such as dipping, fogging, hand spraying and power spraying.

78. Investigations were also made into the biology and host distribution of species of ticks in Northern Rhodesia.

Fiji

79. Trials with Gammexane from a power duster for the control of the stick insect (Graeffea crauani) on coconuts have not been successful, but will be repeated. The Senior Entomologist visited New Guinea for the purpose of bringing back a parasite of the Banana Scab Moth (*Nacoleia octasema.*

Zanzibar

80. *Theraptus Damage to Coconuts.* Investigations into premature nutfall and gummosis of coconuts are being carried out by the Protectorate entomologist.

81. In the laboratory, cross-breeding experiments indicated that *Theraptus* from Zanzibar, Pemba and the mainland constitute one species. There may be varietal differences. Studies of the life histories of this insect and associated ants continued and laboratory tests were made of various formulations of the newer insecticides.

82. In the field, observations on the feeding behaviour of *Theraptus* showed a wider range of host plants. In particular young mango fruits were much used by the insect. Certain parasites and predators of *Theraptus* were observed. An important development was the discovery that certain other insects, notably an ant (*Polyrhacis* sp), a Lepidopteran larva and a weevil, also cause damage hitherto ascribed exclusively to *Theraptus.* The relative importance of these other pests is not yet known nor to what extent control measures applied to *Theraptus* will also deal with these other insects.

83. The only experimental control measure so far applied on a large scale was a double aerial spraying of 500 acres of coconut plantation. This was carried out by Officers of the Colonial Insecticides Research Unit. A DDT in oil formulation was used and full scientific observations as well as costings were made. The results will not be apparent for some months yet.

84. In other spraying and dusting experiments several thousands of palms were treated with various formulations of DDT and other insecticides.

85. Attention was also paid to the problem of effecting a return of *Oecophylla* ants to areas from which they had been driven by *Anoplolepis* and *Pheidole* ants. It is considered that natural biological control in this way is likely to be by far the cheapest and most effective means of controlling *Theraptus.* To this end, spraying experiments for the eradication of the non-useful ants were begun: the insecticide Dieldrex is proving very effective for this purpose. Banding experiments were also undertaken in order to protect young colonies of *Oecophylla* introduced, artificially or otherwise, into the crown of the coconut palms.

APPENDIX

Papers Published or Circulated to the Committee

PUBLISHED

Malaria Eradication Scheme Mauritius Annual Report 1951.

Some Physical factors affecting the efficiency of insecticides. By A. B. Hadaway and F. Barlow. Trans. R. Sec. Trop. Med. Hyg. 46, 236–242, 1952.

Inactivation of DDT by Soils. By A. B. Hadaway and F. Barlow. Nature 170, 762, 1952.

The Development, Construction and Testing of the S.A. 5 Installation as fitted to an Anson I Aircraft for the Dispersion of Insecticides. By R. F. Hill. Porton Technical Paper No. 297, 1952.

The Installation and Testing of the E.A. 3 (Experimental) Exhaust Smoke Equipment fitted in an Avro XIX Aircraft for the Dispersion of Insecticides. By R. F. Hill. Porton Technical Paper 312, 1952.

IN THE PRESS

Studies on Aqueous Suspensions of Insecticides, IV. The Behaviour of Mosquitoes in contact with Insecticidal Deposits. By A. B. Hadaway and F. Barlow.

Aircraft Applications in East Africa—The Deposition in Open Country of Aerosols Released from Aircraft. By D. Yeo and B. W. Thompson.

Atmospheric Turbulence Within East African Tsetse Bush. By B. W. Thompson.

CIRCULATED

Urea Formaldehyde Resin as a Vehicle for Semi-Permanent Marine Anti-fouling Coatings. By P. Bracey.

Progress Report No. 11 of Colonial Insecticide Research Unit, Arusha, Tanganyika.

Chemical Defoliants and Arboricides in Relation to Problems of Tsetse Fly Control in East Africa. By K. Holly.

Defoliants and Arboricides in Relation to Tsetse Fly Control in East Africa. Preliminary Report on a visit to Africa, 1952. By J. D. Fryer.

Urea Formaldehyde Resin as Coatings on Book-bindings Etc. By P. Bracey and F. Barlow.

Aerial Spraying against Tsetse Flies in East Africa Part V. Aerosol Application against G. swynnertoni in Atta Island, Kikore, Tanganyika.

An Experiment to Control the Tsetses *Glossina morsitans* and *G. synnertoni* with DDT treated oxen. By G. F. Burnett.

A Study on the Persistence of DDT on Foliage. By P. E. Burt and J. Ward.

Anatomy of the Tarsi and Pretarsi of Certain Muscid and Tachinid Flies of Medical Importance. By C. T. Lewis.

A Field Trial with Semi-permanent Insecticidal Coatings in a Naval Ship during 1952. By P. Bracey.

Progress Report No. 12 of Colonial Insecticide Research Unit, Arusha, Tanganyika.

Summary of entomological work accomplished during 1951 by the Scientific Team in charge of the Mauritius Malaria Eradication Experiment.

Some observations on laboratory and field experiments dealing with the behaviour and control of mosquitoes in African huts treated with insecticides. By A. B. Hadaway.

A Note on Tests with *A. gambiae* from Mauritius. By A. B. Hadaway.

Interim Report on Experiments on the Deposition of Oil Drops. By A. B. Hadaway and F. Barlow.

Summary of material supplied by Colonial and other Territories on the Control of Plant Diseases in Colonial Territories.

Control of Sorghum Smut. By S. P. Wiltshire.

Control of Black-Pod Disease of Cacao. By C. A. Thorold.

Insecticidal Surface Coatings: Further Progress Reports compiled by the Fungicides and Insecticides Research Co-ordination Service of Trials in Ships of Insecticidal Coatings developed by P. Bracey and F. Barlow.

Colonial Economic Research Committee Sixth Annual Report (1952-1953)

The London School of Economics and
Political Science,
Houghton Street,
Aldwych, W.C.2.
7th August, 1953.

SIR,

I have the honour on behalf of the Colonial Economic Research Committee to transmit to you the sixth report of the Committee covering the period from 1st April, 1952, to 31st March, 1953.

I have the honour to be,
Sir,
Your most obedient servant,
(Sgd.) ARNOLD PLANT.

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL ECONOMIC RESEARCH COMMITTEE

CONTENTS

COLONIAL ECONOMIC RESEARCH COMMITTEE

SIXTH ANNUAL REPORT

(1952–1953)

Membership

PROFESSOR SIR ARNOLD PLANT, Professor of Commerce, University of London, *Chairman.*

PROFESSOR S. H. FRANKEL, D.Sc.(Econ.), Professor of Colonial Economics, University of Oxford.

DR. J. R. RAEBURN, Reader in Agricultural Economics, University of London.

PROFESSOR E. A. G. ROBINSON, C.M.G., O.B.E., Professor of Economics, University of Cambridge.

MR. K. E. ROBINSON, Fellow of Nuffield College and Reader in Colonial Government, University of Oxford.

PROFESSOR R. S. SAYERS, Cassel Professor of Economics, with special reference to Banking and Currency, University of London.

MR. J. R. N. STONE, C.B.E., Director, Department of Applied Economics, University of Cambridge.

PROFESSOR R. C. TRESS, Professor of Political Economy, University of Bristol.

MRS. E. M. CHILVER (*Secretary*).

Terms of Reference

The terms of reference of the Committee are to advise the Secretary of State in connection with economic research and statistics.

SIXTH ANNUAL REPORT

I. INTRODUCTORY

The Committee held three meetings in the course of the year and a special meeting to consider the establishment of an Economic Research Unit at the University College of the Gold Coast.

2. The Chairman was able to visit the East African Institute of Social Research in the course of a visit to South Africa during the summer vacation to advise its Director on the economic aspects of the Institute's research programme. During his visit talks with the Governor of Uganda, Mr. C. J. Martin, Director of the East African Statistical Department, and members of the Uganda Administration on economic research took place. Mr. K. E. Robinson was also able to visit the East African Institute of Social Research in the course of a visit to Uganda in 1952.

3. Professor S. H. Frankel was invited to be a member of the Royal Commission on Land and Population in East Africa.

4. Dr. J. R. Raeburn took part in a visitation of the Institute of Social and Economic Research, University College of the West Indies, at the Principal's invitation, and was able to discuss future work in the field of farm economics with the Director.

II. GENERAL

5. The Committee was able to secure the co-operation of some senior research workers in carrying out important projects: but the recruitment of qualified candidates, whose services are urgently required for teaching in the United Kingdom, still remains difficult.

6. The Committee's decision to invite Universities and University Colleges to propose schemes for economic research has had good results which are recorded in the following section.

7. The balance remaining in the special allocation for economic research at 31st March, 1953, was £63,451. Several projects, for which qualified research workers appear to be assured, will run down this balance in the course of 1953–54. These include assistance to studies of capital formation in "underdeveloped" territories being organised by the Institute of Statistics at Oxford, a study of farm economics in Jamaica, and a study of inter-territorial trade in the British West Indies.

8. Economic studies at the regional Institutes of Social and Economic research were pressed as far as staffing difficulties permitted; and they are described in the Annual Reports of Directors. Towards the end of the year the establishment of a Social Research Unit at the University of Malaya was approved by the University's Senate: it proposes to engage in field studies which involve the use of small teams representing several disciplines, including economics.

III. RESEARCH IN PROGRESS

(i) *Publications in hand*

9. Dr. Greaves' monograph on *Colonial Monetary Systems* will issue very shortly in the Colonial Research Studies series: it is now in the final stages of printing.

10. Mr. P. T. Bauer's study of the *structure and organisation of West African trade* will be published by the Cambridge University Press under the title "West African Trade: a study of monopoly, oligopoly and competition".

11. The report on the *Nigerian National Income,* 1950-51 was completed in the year under review by Dr. Prest and Mr. Stewart and is now being printed by H.M. Stationery Office. An abridged and popular version will be issued simultaneously by the Government Printer, Lagos.

12. Most of Professor Gilbert Walker's study of the *economics of transport in Nigeria* was in draft at the end of the year.

(ii) *Field Studies*

13. In the course of the year, a grant was approved to enable Dr. Fergus Chalmers Wright to carry out a study of the *structure and organisation of the distribution industry in Tanganyika and Nyasaland.* Contributions to the cost of the project were made by the Governments of Tanganyika and Nyasaland. Dr. Chalmers Wright has been able to travel extensively in both territories, visiting all the main centres of population and many villages. He will return to write up his material in June, 1953.

(iii) *Assistance to University Colleges*

14. A scheme was made to assist the East African Institute of Social and Economic Research to recruit an economist to work on the economic aspects of the Kampala Survey of African labour: and at the end of the year an economist was about to be appointed. Funds will also be made available for the appointment of a Senior Economist to plan and take charge of the Institute's economic studies, whenever a candidate can be found.

15. A scheme was also made to promote the study at University College of the West Indies of the methodology of capital formation, with special reference to the course of *capital investment in Jamaica.* A highly qualified scholar has been offered appointment, and work should start in 1953.

16. A grant representing half the recurrent expenditure of an Economic Research Unit at the University College of the Gold Coast until 31st March, 1956, has been made. The unit, which is led by Mr. B. M. Niculescu, is a part of the Department of Economics. Three research workers have already been appointed and are working on a study of internal marketing.

IV. Publications

17. BAUER, P. T. (with YAMEY, B. S.)—*Economic Progress and Occupational Distribution* ; " Economic Journal ", December, 1951.

Competition and Prices: a study of Groundnut buying in Nigeria; " Economica ", February, 1952.

BAUER, P. T. (with PAISH, F. W.)—*The Reduction of Fluctuations in the Incomes of Primary Producers;* " Economic Journal ", December, 1952.

BAUER, P. T.—*The United Nations Report on the Economic Development of Underdeveloped Countries ;* " Economic Journal ", March, 1953.

CUMPER, G. E.—*Productivity and Selective Industrialization ;* " Social and Economic Studies ", Vol. 1, No. 1, February, 1953.

GREAVES, IDA—*Colonial Monetary Conditions ;* H.M.S.O., in the press.

HUGGINS, H. D.—*Employment, Development, Incentive Financing ;* " Social and Economic Studies ", Vol. I, No. 1, February, 1953.

PREST, A. R. & STEWART, I. G.—*National Income of Nigeria* 1950-51 ; H.M.S.O., in the press.

National Income of Nigeria 1950-51 (*abridged edition*), Government Printer, Lagos, in the press.

SIFFLEET, N. (with ROTTENBERG, S.)—*Report on Unemployment in the Presidency of Antigua, Leeward Islands ;* Labour Department, Antigua, Leeward Islands, 1951.

Tsetse Fly and Trypanosomiasis Committee Report for 1952-1953

The Church House,
Great Smith Street,
Westminster, S.W.1.
11th August, 1953.

SIR,

I have the honour to transmit to you the Report of the Tsetse Fly and Trypanosomiasis Committee for the year ended 31st March, 1953.

I have the honour to be,
Sir,
Your obedient servant,
(Sgd.) W. L. GORELL BARNES,
(Chairman).

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE

REPORT FOR 1952–1953

Membership

MR. W. L. GORELL BARNES, C.M.G., Assistant Under-Secretary of State, Colonial Office (*Chairman*).

PROFESSOR P. A. BUXTON, C.M.G., F.R.S., Professor of Medical Entomology, University of London.

CAPTAIN K. F. T. CALDWELL, Formerly of the Kenya Game Department.

DR. J. CARMICHAEL, C.M.G., M.R.C.V.S., Dip.Bact., Formerly of the Colonial Veterinary Service.

PROFESSOR T. H. DAVEY, O.B.E., M.D., D.T.M., Liverpool School of Tropical Medicine.

DR. F. HAWKING, D.M., D.T.M., National Institute for Medical Research.

DR. C. A. HOARE, F.R.S., Wellcome Laboratories of Tropical Medicine.

DR. E. M. LOURIE, M.B., D.P.H., Chief, Section of Biological Standardisation, World Health Organisation.

DR. L. HARRISON MATTHEWS, M.A., F.L.S., Scientific Director of the Zoological Society of London.

MR. W. H. POTTS, Formerly of the East Africa Tsetse and Trypanosomiasis Research and Reclamation Organisation.

MR. W. S. BATES (*Secretary*).

Ex-Officio Members

The Directors of the East African Tsetse and Trypanosomiasis Research and Reclamation Organisation and the West African Institute for Trypanosomiasis Research. The Secretary of State's Chief Medical Officer, and Advisers on Agriculture and Animal Health. The Director of Colonial Medical Research. The Secretary of the Colonial Insecticides, Fungicides and Herbicides Committee. A representative of the Sudan Government.

It is the practice to invite the Scientific Liaison Officer for Southern Rhodesia to attend meetings.

Terms of Reference

The terms of reference of the Committee are:—

> "To consider and advise on the co-ordination of action, including research and reclamation, directed against human and animal trypanosomiasis".

TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE

REPORT FOR 1952–1953

CONTENTS

TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE

REPORT FOR 1952-1953

PART I. MEMBERSHIP OF THE COMMITTEE

Sir Cosmo Parkinson, G.C.M.G., K.C.B., O.B.E., who resigned from the Committee at the end of 1952, had been closely associated for more than forty years with the organisation of trypanosomiasis research and control. The wide knowledge and experience which he had gained during his long career in the Colonial Office remained available after his retirement through his regular attendance at the meetings of the Committee, of which he was a valued member. Dr. F. Hawking, of the National Institute for Medical Research, and Mr. W. H. Potts, until recently Senior Entomologist at the East African Tsetse and Trypanosomiasis Research and Reclamation Organization, have accepted invitations from the Secretary of State to become members of the Committee for a period of three years. Dr. E. Aneurin Lewis became an *ex-officio* member on his appointment to the Directorship of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization.

PART II. THE EAST AFRICAN TSETSE AND TRYPANOSOMIASIS RESEARCH AND RECLAMATION ORGANIZATION

2. Dr. E. A. Lewis, Deputy Director of the Organization since 1949, has been appointed to the Directorship in succession to Dr. H. M. O. Lester, O.B.E.

Introductory

3. Further advances were made during the year in the integration of tsetse research and of research on human and animal trypanosomiasis in East Africa: and a proper balance was established between these two major aspects of the work of this Organization. Experimental reclamation projects have been continued with satisfactory results; and a start has been made on Pilot Schemes of practical reclamation in conjunction with utilization of land, one in each of the three mainland territories.

4. Houses for the staff of the Trypanosomiasis Research Laboratory at Sukulu in Uganda are nearly complete and it is expected that they will be ready for occupation about the middle of 1953. As was stated in the last annual report, the number of houses has had to be reduced because of the rise in building costs in Uganda. Arrangements have therefore been made to post some of the staff to Tinde where accommodation and laboratory facilities are available. The building of the laboratory, out-houses and African quarters was commenced towards the end of the year and is due to be completed in June, 1954. No alterations have been made in the original plan of the buildings which provide accommodation for the full establishment of officers and for visiting scientists. Facilities will also be available for territorial officers with whom arrangements have been made for collaboration in the investigation of human and animal trypanosomiasis.

5. Three Research Officers out of an approved establishment of eight have been appointed to the trypanosomiasis Research Laboratory. The lack of suitable candidates for the vacant posts has slowed up the prepared programme of research, but at Tinde which has been on a care and maintenance basis for over two years it has been possible to resume and extend work on trypanosomes associated with human sleeping sickness; and experiments on animal trypanosomiasis were begun in 1952.

Research on Human Trypanosomiasis

6. Difficulties have been encountered during the last two or three years in obtaining volunteers for tests on the infectivity to man of a strain of *Trypanosoma rhodesiense* which has been maintained by cyclical passage through *Glossina morsitans* in an uninterrupted line from sheep to sheep. These difficulties have now been overcome by increasing the reward to volunteers to a level more in conformity with the pre-war purchasing value of money. The response has been encouraging; it improves the prospects of continuing this important line of investigation and has permitted an extension of studies on the relationship of *T. rhodesiense* of human sleeping sickness and *T. brucei*, a common parasite of stock and of game animals.

7. A number of strains of *T. brucei* have been collected and maintained under strict isolation. Tests on their infectivity to man have proved negative. One strain, however, of what at first seemed to be *T. brucei* has been shown to be capable of producing the disease in human volunteers. Although the full series of experiments and observations of this strain are not yet complete the results so far emphasize the importance of the characteristics. identification and the biological relationship between *T. brucei* and *T. rhodesiense* as well as their reservoirs and their behaviour in man.

8. Cases of sleeping sickness reported to the Organization by the territorial Departments of Medical Services have been plotted on a map of East Africa preparatory to its inclusion in a pan-African map to show the distribution of the disease throughout the continent. These reports and records of outbreaks also serve as a basis for estimates of the quantities of curative and prophylactic drugs that may be required from time to time in order to control human trypanosomiasis in each of the three East African territories.

Research on Veterinary Trypanosomiasis

9. In the field of animal trypanosomiasis the Antrycide Research Scheme was concluded at the end of March, 1952. Interim reports have been issued and published periodically for general information, and a final report has now been submitted. Investigations arising out of these experiments with antrycide have been continued under the general direction of the Trypanosomiasis Research Laboratory. The development of resistance in trypanosomes to the drug has been shown to vary and to depend on length of exposure of treated cattle to continual and repeated infection, to the segregation and isolation of the infected cattle during treatment, and to the management of the animals after treatment. As a curative in the early phases of infection antrycide is an effective drug; it enables the animals to maintain or to recover good condition. Treatment in the later phases of the disease is less effective and relapses are more frequent. There are also indications that relapses are most common with *T. vivax*. Further investigations into the prophylactic properties of antrycide are required for, while it protects animals for varying periods, its suppressive effect on the trypanosome and the danger of spread of the disease by biting flies in the absence of tsetses have yet to be determined.

10. An experiment to assess the role of biting flies in the transmission of the disease to cattle in the field has been undertaken by the Organization in Ankole, Uganda, where *Stomoxys* are abundant in open tsetse free grassland and swamps. Clean herds of cattle into which a beast infected with a known strain of trypanosome has been introduced have been exposed to constant attacks by these flies. Measures have also been taken to ensure interrupted feeds, and to provide opportunities for the spread of infection to the clean animals.

11. Studies are in progress to determine whether an acquired immunity develops in cattle protected with antrycide. Experiments have also been carried out on anti-trypanosome substances in the animal body previously infected with trypanosomes. So far it has been shown that extracts of spleen and liver from animals infected with trypansomiasis have a fairly strong anti-trypanosome action against the homologous strain. Similar extracts from uninfected animals also seem to possess the same property but to a less degree.

Entomology

12. Important advances have also been made in tsetse research. The technique successfully applied to determining the actual population of *G. morsitans* has been extended to another common East African species of tsetse—*G. pallidipes*. It has been found that the capture of one non-teneral male of *pallidipes* over a specified distance represents at least two hundred such flies in a square mile of similar country. The corresponding figures for *G. morsitans* are from twenty-five to fifty.

13. A close correlation has been established between the size of male tsetses in the field and the mean saturation deficit of two months before, which points to an adverse effect on the size of larvae produced by female flies in the dry seasons.

14. Further observations have been made in several areas on the breeding sites of *G. morsitans* and *G. pallidipes, G. swynnertoni* and *G. palpalis*. Considerable data has been collected on the vegetation, soil, soil moisture and temperatures in these sites. The evidence to date shows that the requirements in wet seasons are small patches of bare soil under substantial logs or low drooping thicket and the presence of a perch needed by the female fly while depositing its young. Log sites unproductive of *G. morsitans* pupae were distinguishable by the hardness or wetness of the soil, by tall grass or by deep shade. The average temperature in sites yielding pupae varied from about 21·4°C to 28·4°C according to the area and season. The tolerated range of temperature at any one season seemed to be about 5°C.

15. It has also been shown by a new technique that larvae do not penetrate the surface of the soil wetted by rains and that female flies deposit their young during the wet weather in sites widely distributed throughout the woodland. In the dry season there is a shifting to the sheltered classical sites where larger numbers of pupae are found.

16. Preliminary attempts to raise and to maintain colonies of laboratory-reared tsetses have been encouraging. Most promising results have been obtained with *G. austeni* and *G. swynnertoni* which should be of value to the solution of problems of tsetse physiology and behaviour at Shinyanga and in protozoological studies at Sukulu. Humidity appears to be an important factor; and the host on which the flies feed have an influence on the maintenance and health of the laboratory-bred *G. swynnertoni*. A marked increase in the longevity of a number of flies is of particular interest. It offers wide scope for studies of the infection of flies and the transmission of trypanosomiasis to experimental animals.

17. Field work at Shinyanga has been reduced by the progressive reclamation of the former experimental blocks of bush infested by tsetses. Localities further afield have therefore been selected for the continuation of research on a number of species. These localities are in the vicinity of projects of experimental reclamation or pilot schemes of practical reclamation; and while research officers concerned will return periodically to the laboratory they will also maintain closer contact with their colleagues in the field.

Reclamation and Advisory Services

18. Progress has been made in several directions in schemes of experimental and practical reclamation. An area of about 130 square miles has virtually been freed of *G. morsitans* in the Tabora area by discriminative clearing of bush amounting to about 12½ square miles. In the Lambwe Valley an appreciable drop in the population of *G. pallidipes* has resulted from discriminative clearing of typical thicketed bush. Other patches of thicket or cultivable land have been cleared by settlers who have been introduced by arrangement with the African Utilization and Settlement Board of Kenya. An interesting feature of the work in the Lambwe Valley has been the finding that discriminative clearing acts not only on the tsetse but that it also reduces the proportion of infected flies at the same time as it reduces the flies themselves.

19. The three pilot schemes of practical reclamation in Tanganyika, Kenya and Uganda were begun during the year. Additional and more detailed fly surveys had to be carried out in order to prepare a more precise plan of operations and regular fly patrols have had to be determined and marked. The labour situation in all three territories has been difficult. Nevetheless it has been possible to proceed with clearing and the prospects of more satisfactory progress are now brighter.

20. Full use is being made of aerial photographs in the mapping of vegetation and plotting of the main tsetse habitats with a view to clearing only those sites which are essential to the existence of fly. Measures taken in Ankole have had a significant effect on *G. morsitans* and it appears certain that the advance which has been going on for a number of years has now been checked and the flies pushed out.

21. At Mkata steady progress is being made, and the territorial Departments are supplementing the work of the Organization by additional anti-tsetse measures in the adjoining area where cattle ranching on a larger scale has begun.

22. The Masai scheme in Kenya was held up for several months pending the recruitment of staff, for carrying out more detailed surveys, and the formulation of plans to utilize the land after reclamation. The initial clearing along a base line has recently been started.

23. The advisory services of the Organization have been well utilized by the East African territories, by Southern Rhodesia and Bechuanaland. Officers of the Organization have advised and assisted in surveys and schemes of tsetse control at Songea, Arusha and Magara in Tanganyika; and in Samia and other areas of Uganda. Assistance has been rendered to the Overseas Food Corporation, Urambo, and tc Zanzibar. The Organization has also taken part in experiments on insecticides and defoliants in tsetse infested areas in collaboration with the Colonial Insecticides Research Unit; and has prepared a map of tsetse distribution in East Africa for the incorporation in a pan African map to illustrate the fly belts of the continent.

PART III. WEST AFRICAN INSTITUTE FOR TRYPANOSOMIASIS RESEARCH

Introductory

24. The Annual Report for 1951, the first to be issued, was published during the year. Satisfactory progress has been made in the second year since the Institute was formally opened in 1951. There were no important changes in staff which remained virtually at full strength. The younger members of

the staff have now had sufficient training and experience to enable them to undertake independent investigations and it was therefore possible, for the first time, to initiate research work outside Northern Nigeria. During the year, investigations were carried out in Sierra Leone and the Gambia as well as in Northern and Southern Nigeria.

Entomology

25. For several years past, detailed observations have been made in the field, and latterly in the laboratory, on the ecological requirements of *G. palpalis*, a riverine species of tsetse which is of great importance as a vector of both human and animal trypanosomiasis in West Africa. The enormous amount of data collected has been exhaustively analysed and a lengthy monograph entitled "The Ecology of *G. palpalis* in British West Africa" has been accepted for publication under the joint authorship of Dr. T. A. M. Nash and Mr. W. A. Page.

26. The results of this work have already proved of the greatest value in studying the epidemiology of human trypanosomiasis in Nigeria, Sierra Leone and the Gambia and will doubtless prove equally valuable in the Gold Coast. Another result of immediate practical importance is that these studies have suggested a completely new method for the control of *G. papalis* which promises to be as effective as, and infinitely cheaper than, the older method of partial clearance of riverine vegetation.

27. It has become apparent that certain factors must be satisfied in order to provide a major permanent habitat for *G. palpalis*. These include a vegitational arrangement which ensures to the fly a favourable eco-climate, protection against wind and fire, insulation from the sun and a free flight-line from its breeding places to its feeding grounds. The essence of the proposed new method for the elimination of *G. palpalis* is so to change stream bed vegetation as to impede the movements of this species within the forest eco-climate and to deprive it of insulation from the sun. For this reason the name "obstructive clearing" has been suggested.

28. The technique envisaged is to fell the trees which support and help to form the overhead canopy so that they fall across, or into, the stream-bed. Shrubs, creepers, thickets and giant emergents would be spared. The felled tree-tops and other material would rapidly become overgrown and would be exposed to the full blaze of the sun while the tsetse flight-line along the stream would be obstructed; the form of the fringing forest would thus be changed to a uniform low line of impenetrable thicket with an occasional giant emergent. It would be many years before young trees would force their way through the thicket and develop crowns large enough to suppress the undergrowth.

29. The method would not have universal application but in suitable conditions, whether in savannah or areas of higher rainfall, it would have the advantage of enormously reduced costs as compared with partial clearance since there would be little or no maintenance and no necessity for piling, burning, reslashing or stumping. The proposed new technique cannot be advocated as a proven method until it has been put to practical test; proposals have been submitted for such trials to be undertaken both in savannah and in an area of higher rainfall. There can be little doubt that the conditions which this new method would seek to create would prove effective since it has been observed that where such conditions exist in nature, streams which are choked by dense vegetation are, in fact, free of *G. palpalis*.

30. With the completion of the work on *G. palpalis* the Institute's Field Station at Katabu has been closed down ; it is hoped that under the proposed reorganization of medical research in West Africa the Katabu Field Station will become a centre for malaria research. Meanwhile, preliminary surveys have been carried out with a view to establishing a new Field Station in the rain forest belt to facilitate the study of the high forest species of tsetse about which little is at present known. Several suitable localities have been found in Benin Province but no final decision has yet been taken.

31. Ecological studies on *G. morsitans,* commenced last year at Mokwa, have been continued and extended. Further progress has been made in the study of the systematics of West African tsetse. The collection and recording of data on the distribution of different species have been continued and the importance of this work has been emphasized by the recognition of a serious advance of *G. morsitans* in Northern Nigeria. Although well-known in other parts of the Continent, this is the first occasion on which this phenomenon has been definitely recognised in West Africa. A campaign to arrest this advance has been carried out during the year by the local Government on the basis of recommendations made by Dr. Nash.

32. Laboratory studies on *G. palpalis* and *G. morsitans* have been continued. The laboratory-rearing of *G. palpalis* has now been satisfactorily established and an adequate supply of " clean " flies for experimental work (averaging 1,000 per month) is regularly available. It is proposed to attempt the colonization of *G. morsitans* on a similar scale.

Epidemiology

The Gambia

33. An intensive investigation of the epidemiology of human trypanosomiasis in the Gambia has been completed. Over 55,000 persons were examined covering a very high proportion of the total population of Upper River Division and of representative localities in other provinces. This survey has yielded a clear picture of the epidemiology of the disease in the Colony and Protectorate and has provide a sound scientific basis on which to attempt the amelioration or elimination of the disease.

34. Only three species of tsetse occur in the Gambia, namely, *G. palpalis, G. morsitans* and *G. longipalpis.* The latter is so restricted in its distribution as to be of no practical importance. Despite the wide distribution and prevalence of *G. morsitans* it has been shown that this species plays no part in the dissemination of the human disease. *G. palpalis* is the sole vector.

35. The investigation revealed that the incidence and intensity of sleeping sickness in the Gambia is directly and closely correlated with the intimacy and continuity of contact between man and *G. palpalis.* Wherever contact between man and *palpalis* was found to be close, personal and sustained a high incidence of the disease was encountered ; where contact was impersonal or interrupted the incidence of the disease was lower and where no, or only very occasional, contact occurred the disease was absent. The nature of man-fly contact in the Gambia is determined by a variety of factors including climatic, social and economic conditions, occupation, tribal custom, topography and vegetation.

36. In the western maritime region prevailing high humidity permits *G. palpalis* to disperse freely so that its contact with man, although sustained, is largely impersonal ; sleeping sickness occurs at low to moderate endemicity. In the hinterland, the long dry season is associated with low humidity

and *G. palpalis* is severely restricted both in respect of its perennial haunts and its ability to disperse from them. In many places, especially in the Upper River Division, man-fly contact is very close, personal and sustained and the disease occurs in hyperendemic form in villages close to perennial fly-haunts but is absent in those situated a mile or more from them. Climatic conditions are such as to compel the fly to concentrate in the limited number of situations in which favourable conditions for survival throughout the year are to be found, an occurrence which affords a unique opportunity to effect its elimination at economic cost.

37. Rice cultivation, a prerogative of the women, may provide an exceptional occupational risk and in some localities the incidence of the disease is many times greater in women than in men. It is fortunate, however, that, in the country at large, man is largely isolated from the major haunts of *G. palpalis* which are to be found in the fringing forest of the main river. Liability to flooding compels the inhabitants to site their villages a mile or more from the river banks; the availability of wells dispenses with the necessity for man to visit dangerous fly-haunts to wash and fetch water; little use is made of local craft for transportation on the main waterways and there is little fishing. On the other hand, the lucrative groundnut industry brings about much movement of the population with a consequent risk of disseminating and enhancing the virulence of the disease.

38. The incidence and severity of sleeping sickness in the Gambia has remained at a relatively constant level during the present century and unless there are radical changes in social and economic conditions there is no reason to anticipate an exacerbation of the disease in epidemic form or to expect its further spread.

39. In the maritime region there appears to be no alternative to chemotherapy and chemoprophylaxis for the control of the disease. Elsewhere the elimination of perennial fly-haunts in the immediate vicinity of villages would often be an economic proposition while in Upper River Division there is every reason to believe that the partial clearance of vegetation along a limited number of fresh-water creeks would result in the total elimination of the disease. A pilot scheme in the latter area is now in progress.

40. The findings in the Gambia have been recorded in a detailed report which has been submitted to the Government of the Gambia and an abridged edition has been sumitted for publication as the first paper in a series entitled "The Epidemiology of Human Trypanosomiasis in British West Africa".

Sierra Leone

41. Investigations in Sierra Leone have revealed a set of circumstances which provide a striking contrast to conditions in the Gambia. In Sierra Leone rainfall is greater, temperatures are lower, relative humidities are higher and the dry season is much shorter so that climatic factors generally are more favourable for the survival of *G. palpalis* which, as in the Gambia, has been found to be the sole vector of sleeping sickness.

42. In the rain forest belt of Sierra Leone *G. palpalis* occurs chiefly along the coastal swamps and the main rivers but is rarely found elsewhere. Except for scattered endemic foci, the incidence of sleeping sickness in the rain forest belt is negligible and, owing to the scarcity of *G. palpalis*, is likely to remain so. Although this species is commonly found along the larger rivers the liability to flooding compels the inhabitants to site their villages away from the main water-courses; villages are situated along the smaller tributary streams which are usually so choked by dense vegetation as to be unsuitable

habitats for *G. palpalis*. Should farm-clearings along such streams convert them to suitable fly-haunts and should a reservoir of infection be introduced, localized sporadic outbreaks would be liable to occur as has, indeed, happened in recent years. Localized outbreaks of this kind are difficult to predict but are comparatively easy to control.

43. In the savannah zone and in the transitional zones between rain forest and savannah the introduction of a reservoir of infection would almost certainly result in the rapid and serious spread of the disease on a scale comparable to the vast epidemics which have occurred in other parts of West Africa during this century. So far only one such major epidemic has occurred, in the Kissi tongue protruding between Liberia and French Guinea. Fortunately, this serious epidemic was promptly brought under control by the energetic application of suitable counter-measures.

44. Had the Kissi epidemic, which occurred but a few years ago, been allowed to proceed unchecked there is every likelihood that the transitional and savannah zones of Sierra Leone would have suffered severely. There is,therefore, a vital need for vigilance and for continued efforts to contain the disease in the relatively small area already involved.

45. A full account of the epidemiology of sleeping sickness in Sierra Leone is in course of preparation for publication.

46. Laboratory studies to serve as a check on, and to give precision to, the work in the field have been continued. Several strains of *T. gambiense* have been established in laboratory animals. The accuracy of present field methods for the estimation of protein in the cerebro-spinal fluid has been checked against more elaborate laboratory methods and the need for modifications has been demonstrated. Work has been continued on the use of cultures as an improved diagnostic procedure. Preparations have been made for experiments involving the use of radio-active isotopes for labelling trypanosomes in the vertebrate host with a view to ascertaining their distribution in the body and their behaviour in immune reactions.

Chemotherapy and Chemoprophylaxis

47. Owing to the loss in transit of a standardized batch of Melarsen, further trials with this drug have been delayed but a fresh batch has now been received and has been used for the treatment of human cases in Kano and Benue Provinces.

48. A large-scale experiment with prophylactic pentamidine, commenced in January, 1952, involves the protection of some 2,500 inhabitants of a circumscribed locality in Zaria Province where no other anti-trypanosomiasis measures are in force. Examination of the population after the lapse of nine months showed that no new case of trypanosomiasis had developed among those who had received pentamidine while nine new cases occurred among those who did not receive the drug. The experiment is being continued.

49. Reports on the use of antrycide methyl sulphate for curative purposes continue to be generally favourable. In over 30,000 cattle the results reported were uniformly satisfactory and recorded mortality was only 0·05 per cent. Good results have also been reported in the treatment of dogs but, owing primarily to the greater toxicity of the drug, results in horses were less satisfactory. The failure of antrycide methyl sulphate to control an epidemic of *T. simiae* in pigs was reported previously and later reports indicate that two or even three injections may be necessary to produce a cure. The drug

has achieved remarkable popularity among stock-owners doubtless due to the rapid and dramatic cures produced in cattle.

50. Further observations have been made on the use of antrycide pro-salt as a chemoprophylactic agent in cattle. This drug has not yet been released for general use but it has been employed on a limited scale for the protection of cattle exposed to the risk of infection over long periods. At Kontagora, a small group of cattle has been kept under continuous antrycide prophylaxis for upwards of a year and at Shendam a similar group has been under prophylaxis for nearly two years. The results at both places have so far been satisfactory.

51. Experiments are currently in progress in the laboratory on antrycide resistant strains of *T. congolense*. It has already been shown that a strain of *T. congolense* which was originally susceptible to 0·5 mgm/kilo antrycide methyl sulphate has rapidly become resistant to 10 times this dosage. It is intended to investigate whether this resistance is specific for antrycide or whether it is operative against other drugs.

52. Preliminary experiments with "528" and Ethidium Bromide have been commenced but it is as yet too soon to evaluate the results. It may be said, however, that both drugs have shown marked trypanocidal activity.

Research on Veterinary Trypanosomiasis

53. Investigations have been continued to determine the true nature of the tolerance to trypanosomiasis previously reported in Ndama cattle. Attempts have been made to demonstrate antibodies in the sera of these cattle by both passive immunity and *in vitro* tests. Meanwhile the survivors of experiments previously reported have been subjected to further challenges both by tsetse-bites and by direct blood inoculations, using strains of different geographical origin. There is as yet no indication that the tolerance shown by these animals is either species or strain specific.

54. A long-term experiment is in progress to determine whether cattle will develop an immunity or tolerance to infection as the result of repeated exposure to infection at regular short intervals while under antrycide prophylaxis. In the course of this experiment it has been shown that the serum of cattle thus treated and exposed to infection shows a marked trypanocidal action *in vitro* whereas the serum of cattle receiving antrycide pro-salt but not exposed to infection shows no such action.

Protozoology

55. Special attention has continued to be given to the study of *T. vivax*, a species of prime importance to the live-stock industry in West Africa. It has now been possible to establish a strain of *T. vivax* in white rats without recourse to the use of supplementary inoculations of "clean" sheep or ox serum. The original line which was successfully passaged in rats by the use of supplementary inoculations became independent of serum supplement after 70 serial sub-passages in rats. Meanwhile, it was possible, after 37 serial sub-passages in rats in the supplemented series, to establish a new line which was capable of serial sub-passage in rats without supplement. The course of the infection in the unsupplemented series was observed to differ considerably from that seen in the earlier passages in the supplemented series but the latter showed a gradual change after prolonged sub-passage and, the present time, infections in the two lines have become more or less identical. The supplemented line has been maintained through 131 sub-passages and the unsupplemented line through 120 sub-passages; both lines

were still readily transmissible through *G. palpalis* after 127 and 110 serial sub-passages in rats, respectively. No differences have been detected in the morphology of the trypanosomes in the supplemented line as compared with unsupplemented line.

56. It appears that as a result of prolonged serial sub-passage through rats, *T. vivax* has become partially, if not wholly, adapted to this host. This is evidenced by its ability to infect rats without the use of supplement, by alteration in the course of infection in rats and by considerably increased virulence of the strain for rats. It has been observed, however, that this apparent rat-adaptation is immediately lost when the strain is passed to sheep.

57. Work has been continued on the factors governing the transmission of *T. vivax* by *G. palpalis*. The problem is somewhat complicated by the interplay of a number of different factors among which the mean length of the trypanosome, the temperature at which tsetse pupae have been kept, and the temperature at which adult flies have been maintained appear to influence the infection rate.

58. Observations have been made on the morphology of a number of different strains of *T. vivax* isolated from widely different localities in Nigeria. No differences have so far been detected between these strains but there is evidence to suggest that all differ materially in morphology, and possibly in pathogenicity, from East African strains of *T. vivax*. This point has significance in relation to the results of chemotherapeutic and chemoprophylactic trials carried out in East and West Africa.

59. The fourth paper in the series "Studies on *Trypanosoma vivax*" has been submitted for publication.

Conferences and Committees

60. The Director and members of the staff of the Institute have attended a number of Conferences and Committees during the year. These include the International Scientific Committee for Trypanosomiasis Research at which three papers from the Institute were read, the Tsetse Fly and Trypanosomiasis Committee in London, the Colonial Medical Research Committee, the West African Standing Advisory Committee for Medical Research and the West African Inter-Territorial Conference. The Director carried out a survey of medical research activities in West Africa and subsequently prepared a plan and estimates to give effect to his earlier recommendations which, in a modified form, had received general approval.

61. The above account of the activities of the Institute during the past year is necessarily very superficial but serves to emphasize the wide range of problems now under investigation; however, they represent but a small fraction of the problems awaiting solution.

PART IV. GENERAL

"Animal Trypanosomiasis in East Africa, 1949"

62. The year under review saw the publication by H.M. Stationery Office, after some unavoidable delay, of the survey by Mr. H. E. Hornby, O.B.E., F.R.C.V.S., of "Animal Trypanosomiasis in Eastern Africa, 1949". The report has been widely distributed among those in British Colonial Territories who are concerned with the control of this disease and copies have been made available to many correspondents in foreign countries. In general

Mr. Hornby endorses the recommendations for research which had been drawn up by Dr. H. M. O. Lester as Director of E.A.T.T.R.R.O. and which are now being put into effect. At the same time Mr. Hornby emphasises the importance of a close relationship between research on the disease and on improved methods of range and pasture management. He argues that practical measures of control should be framed in conjunction with others dealing with land usage as a whole ; and it is satisfactory to note that this is the principle underlying the three major pilot schemes of practical reclamation which are now being carried out in East Africa.

Chemotherapy

63. As in previous years the Committee have assisted with the organization of trials with new trypanocidal drugs in Colonial territories and have considered and evaluated the results obtained from these experiments. On their recommendation a new compound, Ethidium Bromide, which from laboratory tests appears to possess marked curative powers against animal trypanosomiasis with very low toxicity, has been made available for trial in both East and West Africa. These experiments are not yet by any means completed, but first results are encouraging. Trials with the melaminyl compounds introduced by Dr. Friedheim have continued in West Africa and there is some prospect that during the forthcoming year it will be possible to recommend that one at least of them should be used on a wide scale in the field. Experiments with one of these compounds, Mel.B, have been carried out on a small scale in East Africa against *T. rhodesiense,* and first results are promising.

International Co-operation

64. The fourth meeting of the Interational Scientific Committee for Trypanosomiasis Research took place at Lourenço Marques in October under the Chairmanship of Dr. F. S. de Cruz Ferreira of the Lisbon Institute of Tropical Medicine. The United Kingdom was represented at the meeting by Dr. J. Carmichael, a member of this Committee, Dr. E. Aneurin Lewis, the Director of E.A.T.T.R.R.O., and Dr. H. Fairbairn and Dr. M. P. Hutchinson, of W.A.I.T.R. The Secretary of the Tsetse Fly and Trypanosomiasis Committee attended in his capacity as Secretary of the I.S.C.T.R. The papers presented to the meeting together with the Final Report of the Conference have been circulated in English and in French by the Permanent Inter-African Bureau for Tsetse and Trypanosomiasis at Leopoldville. It was agreed that no meeting should be held in 1953 and the next session is to take place at Pretoria towards the end of 1954.

65. Mr. W. H. Potts, who returned to this country in 1952 on his retirement from E.A.T.T.R.R.O. and who is now a member of the Committee, has been supervising the last stages in the publication of the map of tsetse distribution for which he has assembled the scientific data. The map is being produced by the Directorate of Colonial Surveys. The first sheet, covering West Africa, has now been published and the remaining two sheets are likely to be available within the next six months.

Sub-Committee on Game

66. Interest has centred on preparations for the Inter-African Conference on the Protection of Fauna and Flora which is being organised by the Commission for Technical Co-operation in Africa South of the Sahara. By invitation of the Belgian Government the Conference is being held at Bukavu in the Belgian Congo and will take place from the 26th-31st October. The United Kingdom will send a strong delegation, which is to be led by Captain

Keith Caldwell, a member both of the Sub-Committee on Game and of the main Committee. A comprehensive agenda has been drawn up, covering every aspect of conservation, control and research. Perhaps the most important task will be to review the action which has been taken to give effect to the provisions of the London Convention of 1933, to re-examine the text of that document and, where necessary, to make recommendations for its revision.

67. Through the courtesy of the authorities of the Zoological Society of London, the British Museum (Natural History) and the Royal Veterinary College arrangements have been made for a course at which members of Game Departments will receive instruction in various scientific subjects which are of value to them. The course will begin at the end of August and will last about five weeks.

68. The Sub-Committee have been happy to learn of the establishment in Uganda of two first class National Parks, one along the Kazinga Channel and the shores of Lake Edward and the other on either side of the Nile from Murchison Falls to Lake Albert. H.M. the Queen has graciously consented to the naming of the first of these the Queen Elizabeth National Park.

Colonial Fisheries Advisory Committee Report on Fisheries Research (1952-1953)

Colonial Office,
The Church House,
Great Smith Street,
Westminster, S.W.1.
27th July, 1953.

SIR,

I have the honour, on behalf of the Colonial Fisheries Advisory Committee, to transmit to you the Committee's Report on Fisheries Research for the year 1952–53.

I have the honour to be,
Sir,
Your most obedient Servant,
(Sgd.) H. HOPKINSON,
(Chairman).

The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

COLONIAL FISHERIES ADVISORY COMMITTEE

Terms of Reference

This Committee was appointed by the Secretary of State for the Colonies in October, 1943, to advise him on problems concerning fisheries (marine and freshwater) in the Colonial Empire.

Membership

THE MINISTER OF STATE FOR COLONIAL AFFAIRS (*Chairman*).

W. B. L. MONSON, C.M.G. (*Vice-Chairman*).

J. CROFT-BAKER, C.B.E.

G. E. R. DEACON, D.Sc., F.R.S.

C. F. HICKLING, C.M.G., Sc.D. (Fisheries Adviser to the Secretary of State).

T. S. LEACH, M.C.

G. F. A. PANTIN, Sc.D., F.R.S.

G. A. REAY, O.B.E., Ph.D.

F. S. RUSSELL, D.S.C., D.F.C., F.R.S.

MISS E. TREVAWAS, D.Sc.

R. S. WIMPENNY, M.Sc.

PROFESSOR C. M. YONGE, D.Sc., Ph.D., F.R.S.

R. H. BURT, O.B.E. (*Secretary*).

COLONIAL FISHERIES ADVISORY COMMITTEE
ANNUAL REPORT ON FISHERIES RESEARCH, 1952–53

CONTENTS

COLONIAL FISHERIES ADVISORY COMMITTEE
ANNUAL REPORT ON FISHERIES RESEARCH
(1952-1953)

I. STAFF

1. *Research Staff.* There is a research staff of 22 officers, with 11 vacancies still to be filled.

2. The recruiting position is normal, and the rate of recruitment is still governed by the rate of progress in building laboratories and houses.

3. *Fisheries Officers.* As explained in last year's Report these officers have administrative and technical duties ; but in the course of their work, results adding to knowledge of fish and fisheries are constantly arising. Therefore, although not research officers, it has been considered appropriate to mention them in this Report.

4. The number of Fishery officers seems to have stabilised at about 54, of whom about 40 are trained expatrite officers. Recruiting and training is now largely concerned with replacements.

II. FINANCIAL POSITION

5. As recorded in the previous Report, the total balance in hand at 31st December, 1951, taking into account cancelled or reduced schemes amounted to approximately £174,300.

During the year 1952 three supplementary schemes and one new scheme were made totalling £46,494 and a credit of £1,500 became available from the balance unspent at the closing down of Scheme R.509, Fisheries Survey Sarawak. The total balance in hand at 31st December, 1952, was therefore approximately £129,300. Commitments for new schemes and for the extension of existing schemes until 31st March, 1956, are now estimated at £85,510 and a further credit of £25,000 is expected to become available from the unspent balance on the completion of Scheme R.71—East African Fisheries Research Organization Jinja 1945–51, leaving an uncommitted balance of approximately £68,800.

III. REPORTS OF INDIVIDUAL COLONIAL FISHERIES RESEARCH STATIONS

The Inter-territorial Fisheries Research Station at Jinja on Lake Victoria

6. The staff consists at present of the Director, Mr. R. S. A. Beauchamp, and three Scientific Officers, Miss R. Lowe and Mr. G. R. Fish and Mr. P. H. Greenwood. There are two Experimental or Field Officers, Mr. Cridland and Mr. Roberts. There is one vacancy for a Scientific Officer.

7. Several visiting scientists from Britain and Europe have worked or are working at Jinja. Subjects investigated include the chemical and physical conditions obtaining in swamps, the habits and food of crocodiles and fish eating birds, and taxonomic and ecological studies on the diatoms. Material has also been collected for the British Museum and the London Zoo.

8. This Station is rapidly achieving the reputation of a research centre of very high standing, comparable in most respects with major European and American freshwater research stations. It is efficiently and economically run.

9. Additional equipment now being installed includes an aquarium and a workshop. The Station's launches, which have borne the brunt of the work during the last three years, now need to be supplemented by a larger vessel able to work on the open waters of the lake, and consideration is being given to the provision of such a vessel.

10. A new technique to determine chemical deficiencies in lake waters has been developed, using algal cultures as indicators. Results prove that not only are nitrates and phosphates in short supply, but also sulphates. In some cases sulphates appear to be the primary deficiency. In most parts of the world, sulphates are abundant in natural waters, and are hence seldom considered as likely to constitute a limiting factor. Although naturally occurring sulphates such as gypsum are scarce in East Africa, remedial measures may prove possible as calcium sulphate may become available as a by-product of the smelting of local copper.

11. Earlier reports have stated that blue-green algae are not digested by *Tilapia,* the most important food fish of Lake Victoria. During laboratory experiments with cultures of algae it was noticed that, in water with a high ratio of sodium to calcium, growth forms of blue-green algae were different from normal, their shape suggesting that the cell walls were more permeable, and thus presumably more digestible.

12. At a later date, field studies on Lake Rudolf showed that *Tilapia nilotica* in that lake digest the blue-green algae which occur there. These fish grow to a great size, exceeding twelve pounds in weight. The waters of Lake Rudolf have a high ratio of sodium to calcium. There appears to be an obvious connection between these two independent lines of research and further investigations will be carried out, as this seems to be a discovery of some importance.

13. A comparison between the productivity of superficially similar swamps has shown that some are highly productive and others are not; for example, the Malagarasi swamps in Tanganyika are very much more fertile than the Kyoga swamps in Uganda. A factor determining the high productivity of the first named appears to be the presence of certain herbivorous and detritus-eating fish. After further investigations, it may be possible to recommend that these fish should be introduced into Lake Kyoga as a large scale experiment. This work is associated with the fact that bottom deposits which consist mainly of vegetable matter decompose slowly, whereas deposits which contain a high proportion of matter of animal origin decompose more rapidly, and so restore their manurial values to the overlying water. Thus, the more animals there are in the lake, particularly herbivorous, the greater the density of animals (including fish) it can support.

14. Considerable advances have been made in studies on the taxonomy of the fishes Haplochromis and Tilapia, while work has continued on the fauna of snails. In connection with the latter, new facts have been discovered concerning the life cycle and hosts of the Schistosomas, parasitic worms which cause the disease Bilharzia in man, and many diseases of animals.

15. An analysis of statistics provided by the Lake Victoria Fisheries Service has thrown new light on the habits and movements of Tilapia fish.

16. It has long been a mystery where the Elephant snouted fish Mormyrus spawn. With the assistance of the echo-sounder, it has been discovered that these fish spawn over rocks emerging from the mud in deep water. Ripe fish have been collected and their eggs fertilised.

17. Data have been collected from 12 lakes in East Africa, including Lakes Tanganyika, Rudolf and Bunyoni.

The Inter-Territorial Marine Fisheries Research Station at Zanzibar

18. The formation period of this Station is nearing its end. The gathering together of staff, gear, apparatus, chemicals and books has taken time; without them little progress can be made, and until they are deployed, no efficient work is possible.

19. The Staff consists of Dr. J. F. G. Wheeler as Director, with Mr. F. Williams and Mr. B. S. Newell as Scientific Officers. A further Scientific Officer, Mr. F. H. Talbot, is nearing the end of his training, and there is one vacancy.

20. Four houses have been built. The Laboratory was completed, and declared open by His Highness the Sultan of Zanzibar, in April, just after the close of the year reviewed here.

21. The research-drifter "Research" made 26 cruises, spending 96 days at sea and covering some 7,000 miles. The main engine ran consistently well throughout, apart from trouble with the pumps, and a serious breakdown in the gear box in September. The hull and standing and running rigging are in first-class condition. A Hughes echo-sounder has been installed and is in working order, and the radio telephone has been re-installed and tested to 170 miles. Cdr. Stevenson has been Master throughout.

22. The emphasis of the work has been on the distribution of the big surface fishes, partly because this is probably the most important line from the economic point of view, and partly because this is the most suitable work with the equipment available. The research drifter is fitted with long "tangons" or spreaders from which up to twelve trolling lines may be fished, and a variety of artificial lures have been used. A total of 402 fishes were caught, weighing 5,266 lbs. or an average of 13 lbs each, and included representatives of 30 species, the big Jacks or Crevallys being most abundant, with the Kingfish second. The monthly catches show that fishes in some numbers are present in both monsoons and can be caught in spite of rough weather. The fish caught are being studied for information as to their habits, migrations and life history.

23. Bottom fishing with hand lines yielded 246 fishes weighing 1,078 lbs., an average of 4 lbs., and included 17 species; but the trawl has so far yielded no worth-while catches.

24. The Station has taken over some marine fishponds, and a tide pole and rafts have been constructed. Biochemical work on the fertility of these ponds, and research on the fish which enter or are stocked in them, will form part of the Station's research programme.

The Joint Northern Rhodesia-Nyasaland and Freshwater Research Station

25. The staff consists of the Scientific Officer in charge, Mr. P. B. N. Jackson, and a Scientific Officer, Mr. D. Harding. There are two vacancies for Scientific Officers.

26. Progress with the building of the Laboratory and houses at Samfya on Lake Bangweulu has been disappointingly slow, but by the end of the year two of the houses were nearly complete and a third had been started.

27. A total of nearly seven acres of fishponds have been completed, together with a furrow to take water from the dam built in 1951. The ponds number 18, and a small office/laboratory has been built.

28. The ponds have been stocked with local species of fish, and three were planted with rice to investigate the possibility of fish culture in rice paddies, as it is practised in the Far East. It appears, however, that the local strains of rice require too small a depth of water for fish culture, and the work will be repeated with strains of rice which require or will tolerate a depth of several inches of water.

West African Fisheries Research Institute

29. The Scientific Staff consists of the Director, Mr. Angus Taylor, and four Scientific Officers, Dr. J. C. D. Watts, Mr. P. Creutzberg, Mr. P. Hansen and Mr. V. Bainbridge.

30. During the year there has been steady progress, and work has been completed on the Administrative and Laboratory block, General Store, Marine Store Mess, and ten staff quarters. The library has been furnished and shelf space provided for 10,000 books. The workshop is fully equipped.

31. The 110 feet research trawler "Cape St. Mary" had a series of mechanical breakdowns and was laid up in November pending the arrival of spare parts and a new complement of Ship's officers. The failure of this fine ship has been a disappointment to all and a serious set-back to the research scheme. She was only able to make a total of 17 exploratory cruises from the Gambia, Sierra Leone, Gold Coast and Nigeria. An otter trawl with 62 foot headline was fished in depths from 6 to 120 fathoms. Records so far indicate that most of the fish are caught in shallow water of 6 to 10 fathoms depth. Larger fish of the same species are found in depths of 18 to 25 fathoms; in depths greater than this, fish appear to be fewer. There is no evidence of discontinuity of species from east to west.

32. The two smaller research launches "Cape St. Paul" and "Cape St. Ann" have by comparison given trouble-free service. They have been employed on a survey of the Freetown Estuary which is to cover two complete years, and which is now being extended to seaward.

33. Some 92 voyages have been made in the estuary by these small vessels during the year, trawling over a standard course with an otter trawl with a 34 ft. headline. Each cruise has included some 4½ hours fishing, and a total of 12,500 lb. of fish has been caught, at an average rate of over 30 lb. per hour's fishing. There are both regional and seasonal variations in the rate of capture. The upper (estuarine) part of the area appears richer in fish than the lower (seaward) part, and catches in the months March to August and September to February were respectively 74·7 and 28 lbs. per hour in the upper grounds, and 23·7 and 15·3 in the lower grounds. A detailed analysis of the 11 principal species caught is being carried out in relation to the breeding cycle, seasonal movements, feeding habits and size distribution.

34. Work is also being done on the hydrography of the estuary; and material was collected over a far wider area during the period when the "Cape St. Mary" was in commission.

35. Continued experiments on the control of marine wood-borers by concussion have shown that, while detonation by small explosive charges greatly decreases the incidence of the common "shipworm" Teredo, it is ineffective against the Martesia wood-borer. The latter prefers to attack sound timber, and a decrease in the incidence of the shipworm was accompanied by an increase in that of Martesia.

The Research Station for Fish Culture in Malaya

36. No progress can be reported. The Director, Dr. C. B. Taylor, resigned in the summer. The Fisheries Adviser visited Malaya in July and August,

and the site originally chosen was found to be unsatisfactory owing to uncertainty as to water supply, and the very swampy nature of the soil, which would have made pond building costs very high. A search is being made for a better site.

The Marine Station at Singapore

37. The Director is Dr. F. D. Ommanney, and two future Scientific Officers, Mr. D. N. F. Hall and Mr. J. H. Wickstead, are completing their training.

38. Plans for the establishment of the station have been delayed by the decision to re-allocate Capital Expenditure so as to provide a larger ship than was originally intended. This re-allocation has involved a reduction in the expenditure on the shore laboratory.

39. It is hoped to build some of the houses in 1953, but there is little prospect that the Laboratory will be built until 1954.

40. One of the Scientific Officers, Mr. D. N. F. Hall, while waiting for accommodation to become available for him at the Station has visited Barbados to undertake research into the relationship between plankton distribution and the presence of flying fish, one of the most important fisheries of the West Indies ; the mission was financed by Colonial Development and Welfare Central research funds. This work will give Mr. Hall valuable experience before he takes up his appointment with the Marine Station at Singapore.

The Marine Research Station at Hong Kong

41. The premises in the University of Hong Kong are being gradually equipped under the direction of Professor Barker, Professor of Zoology at the University, who is the Acting Director of the Station. A substantive Director, Mr. J. A. Tubb, has been appointed and will take up his duties in May, 1953. A small research vessel has been laid down and is expected to be ready for launching in October, 1953.

IV. PUBLICATIONS

42. The following monographs have been published or are in the Press.

Volume I, No. 1. " The Food and Feeding Relationships of the Fisheries of Singapore Straits ", by Tham Ah Kow, B.Sc., 1951.

Volume I, No. 2. " Report on the Tilapias and other Fish and Fisheries of Lake Nyasa ", by Rosemary H. Lowe, B.Sc., 1952.

Volume I, No. 3. " A Preliminary Study of the Physical, Chemical and Biological Characteristics of Singapore Straits ", by Tham Ah Kow, in Press.

Volume I, No. 4. " Report on the Mauritius-Seychelles Fisheries Survey, 1948–1949 ", by Dr. J. F. G. Wheeler and Dr. F. D. Ommanney, in Press.

No. 5. " Fertilisers in Fishponds ", a Review and Bibliography by Dr. C. H. Mortimer, with additional material and a foreword by Dr. C. F. Hickling, in Press.

43. It has been decided to discontinue the use of Volume Numbers for the Colonial Fishery Research Publications after the first four papers as this numbering appears to serve no useful purpose. The publications in future will be numbered consecutively.

V. LONG VACATION STUDENTSHIP

44. During the Long Vacation, 1952, a student from Queen Mary College, London, spent three months at the West African Fisheries Research Institute, assisting in the work of the Institute and gaining experience. The visit was financed by a small grant from Colonial Development and Welfare Central funds.

Report of the Director, Anti-Locust Research Centre, on Locust Research and Control, 1952-1953

Anti-Locust Research Centre,
British Museum
(Natural History),
London, S.W.7.
20th June, 1953.

SIR,

As Director of the Anti-Locust Research Centre, I have the honour to transmit to you a Report on Locust Research and Control for the year 1952–53.

I have the honour to be,
Sir,
Your obedient Servant,
(Sgd.) B. P. UVAROV.

Captain The Right Honourable Oliver Lyttelton,
D.S.O., M.C., M.P.,
Secretary of State for the Colonies.

LOCUST RESEARCH AND CONTROL
1952–53

CONTENTS

LOCUST RESEARCH AND CONTROL
1952-53

ANTI-LOCUST RESEARCH CENTRE

Personnel

1. The new post of Senior Principal Scientific Officer, who would be Deputy Director, was filled only at the end of the report year. A post of Principal Scientific Officer, left vacant due to the secondment of the officer to the International Red Locust Control Service, remained vacant.

2. Two officers of the Desert Locust Survey, Dr. R. C. Rainey and Dr. W. J. Stower were attached to the Centre for several months, analysing the results of their field work. Such temporary attachments of scientific personnel are of great value for the Centre and the field organisations and the principle should be developed further in the interests of anti-locust research as a whole.

Accommodation

3. The Centre occupies a suite of rooms in the British Museum (Natural History), which are no longer sufficient for the accommodation even of the present personnel some of whom have to work in uncongenial conditions, and visiting scientists from overseas cannot be offered adequate facilities for work. For this reason, requests from foreign countries to take up some trainees, who would otherwise be most welcome, have to be refused. This unsatisfactory position hampers the work and requires adjustment.

Locust information service

4. During the year, 1,265 (1,140 last year) reports on the locust situation have been received from 41 countries and territories. Recent wider developments in the current Desert Locust plague (para. 28) imposed a great strain on the Geographical section of the Centre, in which current reports on the situation have to be analysed and mapped without delay, to be used in the preparation of monthly summaries and forecasts which are distributed freely to all affected countries. This is a task of recognised international importance carried out by the Centre without outside financial assistance. In addition to the monthly summaries, special reports and long-range forecasts of developments in the locust situation are prepared, as need arises, in connection with planning of seasonal campaigns by the Desert Locust Control Advisory Committee of the United Nations Food and Agriculture Organisation to which the Director of the Centre is the official consultant.

Scientific information service

5. Current literature on locusts and grasshoppers and their control is being regularly collected in the library and *Acridological Abstracts* are being prepared and circulated to research workers in all countries. During the year 336 abstracts were sent out. Enquiries from research workers are frequently received and references to specific subjects are compiled.

Tours and conferences

6. The Director attended meetings of the Provisional International Council for the Control of the African Migratory Locust at Segou, French Sudan, in May; the Desert Locust Survey Advisory Committee at Nairobi in June; the International Red Locust Control Council at Abercorn, Northern Rhodesia, in July; and meetings of the F.A.O. Advisory Committee on Desert Locust Control in Rome in March and November. Miss Z. Waloff, Principal Scientific Officer, was in East Africa from August till the end of December conducting field investigations (see para. 21).

Publicity

7. Lectures on the locust problem were given by the Director at the University of London Institute of Commonwealth Studies, and at the Symposium on the biology of deserts organised by the Institute of Biology in London. In the latter lecture evidence was presented that agricultural development of desert countries is likely to increase the economic importance of the Desert Locust, which is favoured by irrigation of desert areas. In connection with the current Desert Locust plague, articles were contributed from time to time to the Press. A documentary film on the control of locusts by modern methods with special emphasis on the value of international co-operation, was produced by the World Wide Pictures Ltd., under the sponsorship of the United States Mutual Security Agency and with technical assistance from the Centre and the Desert Locust Survey and Control.

Locust Laboratory

8. About half a million locusts were hatched during the year ; most of them were used for research in the Centre, others were supplied to extra-mural research workers in this country and abroad. Stocks of locusts regularly bred in the laboratory now include the three main African species, the Desert, the Migratory and the Red Locust, while two species of large grasshoppers are also bred for comparative studies.

9. Mr. P. Hunter-Jones completed an investigation into factors affecting the colour and weight of newly hatched Migratory Locust hoppers ; it was found that the degree of parental crowding was the main factor and this suggests a form of transmission of phase characters from the parent to the offspring.

10. Dr. M. J. Richards studied factors affecting the rate of sexual maturation in the Desert Locust. Delayed maturation in isolated pairs, occurring mainly during the summer months, can be avoided by subjecting the locusts to high air humidity, but there appears to be also a seasonal factor present, the nature of which is obscure. The mechanism by which mature males stimulate younger ones to precocious maturation has now been shown to be of a chemical-olfactory nature.

11. Miss P. Davey completed her work on feeding of locust hoppers. Evidence was obtained that the size of particles of bran used in baits is important, since hoppers eat appreciably more of small particles than the larger ones. Data were also obtained on the weight of grass eaten by locusts throughout the life-history.

Extra-mural research

12. Dr. Peggy Ellis, at University College, London, established that concerted marching of hoppers is due to their visual response to other moving hoppers. The ability of hoppers to aggregate which is responsible for the formation of hopper bands, was found to depend on " learning " and hoppers reared in isolation developed a tendency to aggregate after only 24 hours of crowding. Dr. Ellis carried out field investigations in Ethiopia (para. 22). Mr. Chapman continued studies on roosting behaviour of hoppers.

13. Dr. T. Weis-Fogh in Copenhagen, produced an important paper on fat combustion by flying locusts and continued investigations on flight dynamics, water and heat balance in flight.

14. Following Dr. Goodwin's studies of biochemistry of locust pigments, Mr. B. Nickerson, at King's College, London, commenced work on their histological distribution and on the phase pigmentation changes apparently

regulated by hormones. Genetical aspects of phase variation are being studied at the Birmingham University by Mr. A. Jamieson.

15. Two research students at the Imperial College of Science were working on ecological problems. Mr. J. P. Dempster carried out field and laboratory research on the choice of habitats by grasshoppers, on mortality rates in locusts and grasshoppers and on population dynamics. Mr. J. C. Basu-Choudhuri investigated reproductive behaviour of the Migratory Locust, and oviposition habits of the locust and of British grasshoppers.

16. Miss C. M. Myers and Dr. L. Friedler, at St. Mary's Hospital Medical School, continued investigations on detoxication in locusts.

17. Persistent efforts by the Centre to popularise the locust as a laboratory animal have led to the establishment of locust stocks in a number of universities where they are used for teaching purposes and for research. As a result, a number of investigations have started, in which locusts are used, without direct support by the Centre, mainly on fundamental problems which would otherwise have to wait their turn for many years. Such independent extra-mural research was carried out on neuro-muscular transmission (Glasgow); biochemistry of locust blood (Leeds and Newcastle-upon-Tyne); optical nerve impulses (Newcastle-upon-Tyne); analyses of locust fat (Liverpool; in conjunction with Miss Z. Waloff's work, see para. 21); respiratory metabolism in relation to growth (Nottingham); blood micro-organisms (University College, London); nucleo-proteins of locust sperm (King's College, London); effects of ionising radiation on cell survival (Harwell); locust allergy amongst laboratory workers (St. Mary's Hospital, London).

Taxonomic research

18. The preparation of the Catalogue of African Acrididae by Mr. H. B. Johnston is approaching its final stage. Some 900 publications were examined, and about 18,000 reference slips are being used in preparing the final text. Dr. V. M. Dirsh continued work on a revision of *Catantops* and allied genera and published several papers on new genera and species of African grasshoppers.

Biogeographical research

19. The last in the series of four Memoirs dealing with the generalised regional schemes of seasonal breeding and migrations of the Desert Locust has been published. In spite of the growing amount of work involved in plotting of current reports and preparation of monthly summaries and forecasts, good progress has been made in the analysis of the current and the preceding Desert Locust plagues, season by season.

Statistical work.

20. Statistical section, under Mr. D. E. Davies, was active in analysing data in connection with biometrical work, field data of Miss Z. Waloff (para. 21), of the Cyprus Locust Research Team (para. 27), and of the laboratory experimental data.

Field researches

21. A joint Field Research Unit of the Desert Locust Survey and the Centre led by Miss Z. Waloff, with three technical assistants, motor transport and a two-seater Auster aircraft carried out investigations, on the Somali Peninsula, on swarms of Desert Locusts, during August-November, 1952. The season and area were chosen so as to cover a wide range of weather

conditions, and the results obtained throw some light on the mechanism of displacements associated with the seasonal movements of the Inter-Tropical Convergence zone (para. 26). The behaviour of flying locusts was investigated by means of photographic technique which provided valuable data on orientation in flight and on swarm structure in different weather conditions. Attention was paid to the physiological state of the swarms observed and the material obtained provided information on the weight changes of locusts in relation to maturation, and on moisture and fat contents changes in relation to external conditions and activity. Analysis of fat samples was carried out under supervision of Dr. M. L. Meara at the Liverpool University, by arrangement with the Colonial Products Research Council.

22. Dr. Peggy Ellis, with a party equipped by the Desert Locust Survey, conducted preliminary observations on the behaviour of Desert Locust hopper bands in Ethiopia and Eritrea, particularly with regard to the type and rate of movement in relation to vegetation. These investigations had to be interrupted due to the lack of bands, caused by effective control operations.

Research on control

23. Responsibilities of the Centre in this direction have been reduced because regional organisations have appointed their own personnel to investigate insecticides and machinery specially suitable for local conditions. In addition, investigations are undertaken by industry, in consultation with the Centre. Work at the Chemical Defence Experimental Establishment, Porton, on the pick-up of spray by flying locusts was concluded and a report is in the Press. This work was of exceptional value in developing the method of spraying locusts in flight (para. 26).

REGIONAL ORGANISATIONS

International Red Locust Control Service

24. This Service is now directed by Dr. D. L. Gunn, seconded from the Centre, and the scientific side of the organisation is actively developing. Mr. D. Vesey-Fitzgerald continued ecological studies of vegetation types in the outbreak areas and obtained evidence of the importance of disturbed drainage on locust breeding. Dr. O. W. Richards was invited to visit the Rukwa Valley in order to study and advise on methods of estimating locust populations; his report is in the Press. Mr. F. Albrecht, studying the life-cycle of the Red Locust provided evidence that sexual maturation and egg-laying in this species can be accelerated by high humidity and temperature.

Provisional International Council for the Control of the African Migratory Locust

25 A research mission under Mr. J. T. Davey, seconded from Nigeria, obtained ample evidence of the importance of seasonal movements of adult locusts from and to the outbreak area. This finding constitutes an important advance in the knowledge of the origin of outbreaks.

Desert Locust Survey

26. The main progress in research activities of the Survey during the year included the advancement by Dr. R. C. Rainey of a new hypothesis connecting migrations of Desert Locust swarms with seasonal movements of weather fronts (in particular, of the Inter-Tropical Front), which should make forecasting of invasions more accurate; very detailed field investigations by Dr. W. J. Stower of hopper colour types in relation to population density,

behaviour and external factors ; and geographical, botanical and acridological exploration of less known areas of Arabia, Libya and the island of Socotra. Carefully planned tests of spraying swarms in flight from aircraft were eminently successful ; thus, a flying swarm estimated to weigh 60-80 tons was killed by a single application of only 50 gallons of spray containing 55 lbs. of 11 per cent. benzine-hexachloride, at the net cost of £195. This method adds a new tactical weapon for locust control, as swarms in flight have otherwise been immune from attack. Other field researches by the Survey were undertaken jointly with the Centre (paras. 21 and 22).

Cyprus Locust Research Team

27. Since the effects of overgrazing on the Moroccan locusts have been established by previous observations, experiments were started on enclosed plots. An important factor in population dynamics of the locust was found to be the seasonal movements of hoppers and adults from one type of vegetation to another, and the ecological significance of these migrations was studied. Egg-predators, including a beetle and hover-flies, appear to play a substantial part in controlling locust populations, while their incidence is connected with the distribution and flowering period of certain plants.

LOCUST CONTROL

28. The locust situation in the outbreak areas of the African Migratory and the Red Locust continued to cause no concern, as the respective permanent international services (paras. 24 and 25) keep the areas under close supervision and suppress any increases in the local locust population.

29. As a striking contrast, the Desert Locust situation during the year has been extremely serious, particularly on the Somali Peninsula and in Arabia. The situation in the Somali Peninsula and in the coastal areas of Saudi Arabia was brought under control by the Desert Locust Control Organisation of the East Africa High Commission, working in co-operation with the Saudi Arabian and Ethiopian authorities and the Trusteeship Administration of Somalia. In other parts of the Arabian peninsula, however, locust breeding occurred on such a scale that even the combined efforts of several nations, stimulated and assisted by the Food and Agriculture Organisation of the United Nations, were unable to prevent escapes of swarms. In addition, certain large areas of Arabia became closed to control because of boundary disputes. Thus, although East African territories were saved from invasion, the plague has not diminished in its intensity, while its extent is on the increase.

30. It became abundantly clear during the year that national efforts of some countries were inadequate to achieve complete control of locusts within their own territories, and that these countries were unable to provide sufficiently strong forces to operate beyond their frontiers, in the desert areas where the invading swarms arise. The Food and Agriculture Organisation were recommended by the Advisory Committee on Desert Locust Control that the efforts to stimulate and to co-ordinate national efforts against the Desert Locust plague should be greatly intensified, particularly on the Arabian peninsula.

APPENDIX I

ADVISORY COMMITTEE ON ANTI-LOCUST RESEARCH

Membership

SIR GEOFFREY EVANS, C.I.E., M.A., Royal Botanic Gardens, Kew (*Chairman*).

MR. G. A. BULL, B.Sc. Meteorological Office, Air Ministry.

PROFESSOR G. R. CAMERON, D.Sc., M.B., B.S., F.R.S., Professor of Morbid Anatomy, University College Hospital Medical School, University of London.

SIR GEOFFREY CLAY, K.C.M.G., O.B.E., M.C., Agricultural Adviser to the Secretary of State for the Colonies.

AIR-COMMODORE K. D. G. COLLIER, C.B.E., Ministry of Supply, D.Arm., R.D. (Air).

DR. W. J. HALL, C.M.G., M.C., Director, Commonwealth Institute of Entomology.

MR. S. T. A. MIRRLEES, M.A., Meteorological Office, Air Ministry.

DR. E. A. PERREN, Chemical Defence Experimental Establishment, Ministry of Supply.

MR. R. E. RADFORD, Colonial Office.

DR. O. W. RICHARDS, M.A., Reader in Entomology, Imperial College of Science and Technology.

MR. N. D. RILEY, C.B.E., Keeper of Entomology, British Museum (Natural History).

DR. B. P. UVAROV, C.M.G., F.R.S., Director, Anti-Locust Research Centre.

PROFESSOR G. C. VARLEY, M.A., Ph.D., Hope Professor of Zoology (Entomology), University of Oxford.

DR. V. B. WIGGLESWORTH, C.B.E., M.A., F.R.S., Director, Agricultural Research Council Unit of Insect Physiology. Reader in Entomology, University of Cambridge.

DR. C. B. WILLIAMS, M.A., Chief Entomologist, Rothamsted Experimental Station.

MR. A. T. THOMPSON, Secretary, Anti-Locust Research Centre (*Secretary*).

APPENDIX II

List of Publications

ANTI-LOCUST BULLETINS

GUNN, D. L., HUNTER-JONES, P., & DAVIES, D. E., 1952. Laboratory experiments on phase differences in locusts.—*Anti-Locust Bull.*, London, No. 12: [2+] 35 pp., 5 figs.

NORRIS, M. J., 1952. Reproduction in the Desert Locust (*Schistocerca gregaria* Forsk.) in relation to density and phase.—*Anti-Locust Bull.*, London, No. 13: [2+] 49 pp., 8 figs.

POPOV, G., 1953. Investigations of suspected outbreak areas of the Desert Locust (*Schistocerca gregaria* Forskål) in Iran.—*Anti-Locust Bull.*, London, No. 14: [2+] 30 pp., 3 maps, 8 pls.

ANTI-LOCUST MEMOIR

FORTESCUE-FOULKES, J., 1953. Seasonal breeding and migrations of the Desert Locust (*Schistocerca gregaria* Forskål) in south-western Asia.—*Anti-Locust Mem.*, London, No. 5: 35 pp., 14 maps, 1 fig.

JOURNAL PAPERS, written by members of the staff, sponsored or otherwise assisted by the Centre.

AGARWALA, S. B. D., 1952. A comparative study of the ovipositor in Acrididae—I. —*Indian J. Ent.*, New Delhi, **13** (1951): 147–181, 35 figs.

AGARWALA, S. B. D., 1952. A comparative study of the ovipositor in the Acrididae —II.—*Indian J. Ent.*, New Delhi, **14**: 61–75, 26 figs.

ALBRECHT, F. O., 1952. The reliability of the E/F ratio, a measure of phase status, in fresh and in dried locusts (Orthoptera).—*Proc. R. ent. Soc. Lond.*, (B) **21**: 167–169, 1 fig.

ALBRECHT, F. O., 1953. The breeding of the Red Locust in captivity.—*Bull. ent. Res.*, London, **44**: 1–4.

CHEU, S. P., 1952. Changes in the fat and protein content of the African Migratory Locust, *Locusta migratoria migratorioides* (R. & F.).—*Bull. ent. Res.*, London, **43**: 101–109, 1 fig.

DIRSH, V. M., 1951. Some new and little known African Acrididae (Orthoptera). —*Proc. R. ent. Soc. Lond.*, (B) **20**: 73–79, 17 figs.

DIRSH, V. M., 1952. The restoration of the subfamily Trigonopteryginae Walker (Orthoptera, Acrididae).—*Ann. Mag. nat. Hist.*, London, (12) **5**: 82–84, 1 pl., 6 figs.

DIRSH, V. M., 1952. A study of the genus *Tropidauchen* Saussure (Orthoptera, Acrididae).—*Proc. R. ent. Soc. Lond.*, (B) **21**: 94–109, 1 map, 2 pls., 35 figs.

DIRSH, V. M., 1952. Two new genera of the subfamily Acridinae (Orthoptera, Acrididae).—*Proc. R. ent. Soc. Lond.*, (B) **21**: 135–139, 13 figs.

DIRSH, V. M., 1952. A new species of the genus *Leptea* Bolivar (Orthoptera, Acrididae).—*Proc. R. ent. Soc. Lond.*, (B) **21**: 147–148, 6 figs.

DIRSH, V. M., 1952. Studies on new and little known African Acrididae (Orthoptera).—*Rev. Zool. Bot. afr.*, Brussels, **46**: 258–268, 24 figs.

DIRSH, V. M., 1953. Charilainae, a new subfamily of Acrididae (Orthoptera).— *Ann. Mag. nat. Hist.*, London, (12) **6**: 161–173, 6 figs.

DIRSH, V. M., 1953. New and little known South African Acrididae (Orthoptera). —*Ann. Mag. nat. Hist.*, London, (12) **6**: 375–381, 1 pl., 2 figs.

ELLIS, P. E., 1953. Social aggregation and gregarious behaviour in hoppers of *Locusta migratoria migratorioides* (R. & F.).—*Behaviour*, Leiden, **5**: 225–260, 10 figs.

EVANS, E. J., 1952. The stridulation noise of locusts.—*Proc. R. ent. Soc. Lond.*, (A) **27**: 39–42, 2 pls., 1 fig.

GOODWIN, T. W., 1952. The biochemistry of locust pigmentation.—*Biol. Rev.*, Cambridge, **27**: 439–460, 2 col. pls.

GUNN, D. L., 1952. Control of Red Locusts by insecticides.—*J. Sci. Fd. Agric.*, London, N. 7: 289–296.

KROGH, A. & WEIS-FOGH, T., 1952. A roundabout for studying sustained flight of locusts.—*J. exp. Biol.*, Cambridge, **29**: 211–219, 5 figs.

LE PELLEY, R., 1952. Note on damage to grazing by grasshoppers in Kenya.—*Bull. ent. Res.*, London, **43**: 79–81.

POPOV, G., 1952. Apparent tendency to phase variation in an Iranian grasshopper, *Pyrgodera armata* (F.W.) (Orthoptera, Acrididae).—*Eos., Madr.*, **28**: 277–283, 2 pls., 1 fig.

SHULOV, A., 1952. The development of eggs of *Schistocerca gregaria* (Forskal) in relation to water.—*Bull. ent. Res.*, London, **43**: 469–476.

SMITH, K. D. & POPOV, G. B., 1953. On birds attacking Desert Locust swarms in Eritrea.—*Entomologist*, London, **86**: 3–7, 1 map.

UVAROV, B. P., 1952. Studies in the Arabian Orthoptera.—III. New genera, species and subspecies collected by the Anti-Locust missions.—*J. Linn. Soc.* (*Zool.*), London, **42**: 176–194, 55 figs.

UVAROV, B. P., 1952. Description of adult *Schizodactylus inexspectatus* (Werner) from Turkey (Orthoptera, Gryllacrididae).—*Ann. Mag. nat. Hist.*, London, (12) **5**: 772–774, 1 pl., 2 figs.

UVAROV, B. P., 1953. Some effects of past climatic changes in the distribution of African Acrididae.—*Trans. IXth int. Congr. Ent.*, Amsterdam, **2**: 157–158.

UVAROV, B. P. & DIRSH, V. M., 1952. Orthoptera collected in Iran.—*Verh. naturf. Ges. Basel*, **63**: 1–16, 4 figs.

WALOFF, Z., 1953. Notes on the Orthoptera in Cyprus, April, 1950.—*Proc. R. ent. Soc. Lond.*, (A) **28**: 24–30.

WALOFF, Z., 1953. Flight in Desert Locusts in relation to humidity.—*Bull. ent. Res.*, London, **43**: 575–580, 1 fig.

WEIS-FOGH, T., 1952. Fat combustion and metabolic rate of flying locusts (*Schistocerca gregaria* Forskål).—*Phil. Trans.*, London, (B) **237**, No. 640: 1–36, 12 figs.

(21021) Wt. 819—6328 K16 10/53 D.L.