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COLONIAL OFFICE

COLONIAL RESEARCH
1951—1952

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
September 1952

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REPORTS IN THIS VOLUME

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

Colonial Research Council Annual Report on Colonial Research 1951-1952

Colonial Office,
The Church House,
Great Smith Street,
Westminster, S.W.1.
3rd July, 1952.

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 1951–52.

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., R.F.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. J. G. HIBBERT, C.M.G., M.C. (*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 ON COLONIAL RESEARCH FOR 1951–52

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
(1951-1952)

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. The Parliamentary Under-Secretary of State (The Rt. Hon. the Earl of Munster) became Chairman of the Council in October. Sir David Hughes-Parry replaced Sir Alexander Carr-Saunders as a member of the Council, on succeeding the latter as Chairman of the Colonial Social Science Research Council in the autumn. Professor Tawney's period of appointment expired during the year.

3. The Chairman visited the West Indies during March and April 1952. Sir Harold Himsworth visited Nigeria and the Gold Coast at the end of March 1952, and Dr. Norman Wright visited Trinidad and Jamaica during February and March 1952.

4. The Council has noted with much concern the increasing difficulties arising from the uncertainty regarding the provision of further Colonial Development and Welfare funds after the present Acts expire in March, 1956. This is not only rendering the planning of long-term research impossible, but is also a most adverse factor in the way of recruiting research workers for the Colonial territories. The Council sincerely trust that the position will be clarified at the earliest possible date.

5. The Council wish to stress the great importance of direct contact between research organizations and institutions in this country and the Colonial territories, which is bound to prove of mutual benefit. They have, therefore, noted with much satisfaction the useful activities performed by the travelling Colonial liaison officers on the staffs of the Building, Road and Pest Infestation Stations of the Department of Scientific and Industrial Research, and by the Tropical Soils Adviser at the Rothamsted Experimental Station, and hope that other such appointments will be made whenever circumstances justify them and finance permits.

6. The Council also attach much importance to members of the various specialist research advisory committees visiting the territories where schemes sponsored by the Committees are in operation, and are especially glad to note the arrangements now being made for regular visits to East and West Africa by members of the Colonial Medical Research Committee. They hope that this practice will be adopted by other committees when opportunity offers and finance permits. Conversely, the Council welcome the opportunities which are now being given for research workers from the Colonies who are on leave in this country to attend meetings of the specialist advisory committees and to give first-hand progress reports.

I. GENERAL

Colonial Development and Welfare Research Schemes made in 1951/52 *and their cost*

7. 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.

As was forecast in last year's report,* the limitation of funds imposed as from October 1950, resulted in a substantial reduction in the number and size of the schemes. Some 36 new schemes and some 53 supplementary schemes were made, involving grants totalling £868,851. (These compare with 57 new and 60 supplementary schemes made during the previous year entailing grants totalling over £2½ million.) 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 £11,100,000. From this last figure must, however, be deducted some £962,000 arising from unspent balances on completed schemes, revision of schemes, etc., so that the net expenditure and commitment on the 31st March, 1952, was of the order of £10,140,000, of which some £9·94 million 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 nearly £5½ million.

8. About 32·7 per cent. of the gross allocation of £11,100,000 has been for agricultural, animal health and forestry schemes, 13·9 per cent. for medical research, 13·8 per cent. for fisheries research, 11·7 per cent. for tsetse and trypanosomiasis research, 8·8 per cent. for social science and economic research, 6·2 per cent. for insecticides research, 4·6 per cent. for research sponsored by the Colonial Products Research Council, 3·5 per cent. for anti-locust research, and 4·8 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, 18·3 per cent. for the West African group, 11·1 per cent. for the South-East Asian territories and Hong Kong, 8·7 per cent. for the West Indian Colonies, British Guiana and British Honduras, 6·2 per cent. for the Central African territories (Northern Rhodesia and Nyasaland), and 16·7 per cent. for other territories and for schemes of general interest.

9. The new schemes made during the year under review include pilot schemes for the reclamation of tsetse-infested areas in Kenya, Uganda and Tanganyika, experiments in East Africa with the dissemination of insecticides from fixed-wing aircraft, the establishment of a veterinary research laboratory and other facilities in Malaya, the re-establishment of the herbarium at Sandakan, North Borneo, and the appointment of a botanist, research into the maize rust disease in West Africa, an ecological land-use survey in British Honduras, the establishment of a pool of plant pathologists at the Commonwealth Mycological Institute, primarily to assist the smaller Colonial territories, and the equipping and maintenance of observation stations in the Windward and Leeward Islands to detect and record seismic activities. The supplementary schemes include further provision for the West African Institute of Social and Economic Research, for the training of ecologists, for the development and maintenance of the West African Rice Research Station at Rokupr in Sierra Leone, and for the clove and coconut researches in Zanzibar. The West African schemes are of particular importance.

Colonial Research Service

10. 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 been agreed by the West and Central African Governments. At the end of the year this matter was still under consideration by the East Africa High Commission and the East African Governments.

* Cmd. 8303

11. The application of further revised scales introduced in the United Kingdom Scientific Civil Service fo the grades of Senior Scientific Officer and Scientific Officer is under consideration in consultation with Colonial Governments. In a number of areas, the revision of local Colonial Service salary scales has necessitated adjustment of Overseas Research Allowances. Elsewhere, local temporary cost-of-living allowances have been introduced and these have been applied similarly to members of the Colonial Research Service in the territories.

Research Appointments

12. Seventeen appointments were made during the year under review, including the Director of the West African Building Research Station. Following recommendations by the Colonial Research Council as to the general principles which should guide selection, about 90 posts in the Colonial Agricultural, Veterinary and Medical Services have been accepted for inclusion in the Colonial Research Service and about 40 officers in these posts desiring to transfer have been declared suitable.

Colonial Research Fellowships and Studentships

13. No Fellowships were awarded during the year. Fifteen Studentships were granted of which two were in ecology, five for fisheries research, one for insecticides research, two for medical research, four in soil science, and one for veterinary research. Further Studentships will be awarded in 1952.

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

14. The Scientific Council pursued its policy of meeting at different centres in Africa by holding its second full meeting at Dakar in November. Earlier in the year its Executive Committee, consisting of the Chairman (Dr. P. J. du Toit, F.R.S., of South Africa), the Vice-Chairman (Professor J. Millot, of Madagascar), and the Secretary-General (Dr. E. B. Worthington), had met in London at the same time as a Special Conference of the participating Governments which had been convened to discuss the form of the instrument constituting the Council and its relationship with the Commission pour la Cooperation Technique en Afrique au Sud du Sahara (" C.C.T.A."). It was agreed that the Council should act as scientific adviser to the C.C.T.A.

15. At the Dakar meeting the Council reviewed the whole field of science of importance to the development of Africa and selected a few subjects for special study immediately, namely, surveys and maps, geology, zoology, hydrobiology and fisheries, research into the abilities of African peoples, and library services. The Secretariat of the Council was established on the assumption of duties by the Secretary-General in June, since when he has travelled extensively in various parts of Africa. The Secretariat is based temporarily at the Muguga agricultural research institute near Nairobi with the intention of moving to the Kivu area of the Belgian Congo in due course.

16. Publication No. 1 of C.S.A., a brochure describing its origin and objects, has been issued and work has advanced on a report on activities since the Council's inception, an informative list of the scientific institutes and organizations in Africa south of the Sahara, a directory of scientific and technical libraries, and a list of topographic and special subject maps available for the region.

17. The members of Council representing the United Kingdom and the Colonies are Sir Alexander Carr-Saunders, F.B.A., Dr. B. A. Keen, F.R.S., and Col. H. W. Mulligan, with Sir Frank Engledow, F.R.S. and Dr. H. H. Storey, F.R.S. as alternate members.

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. Mr. D. W. Hall was appointed Colonial Liaison Officer with the Pest Infestation Laboratory and visited East Africa early in 1952. Reference to this visit will be found in the report of the Committee for Colonial Agricultural, Animal Health and Forestry Research.

19. It was decided, for financial reasons, not to proceed with the appointment of a Liaison Officer at the Torry Research Station.

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

20. Work under four of the E.C.A. projects mentioned on page 10 of the 1950–51 report (Kafue Flats; Schistosome-transmitting snails in West Africa; leaf-scald of sugar cane, and laterization in West Africa) started or was continued in 1951–52.

21. An American plant breeder visited Nigeria to investigate the breeding of improved grain sorghums and maize, and an entomologist was secured to undertake research in Northern Rhodesia into the control of ticks affecting livestock.

22. In the course of visits to the United States under the auspices of the Economic Co-operation Administration, Mr. S. T. Hoyle, Chief Agricultural Research Officer, Nyasaland, studied the breeding of tobacco and maize; Mr. J. M. Fraser, Manager of the Singapore Improvement Trust, studied town planning and associated problems; Mr. J. K. H. Wilde, Chief Veterinary Research Officer, Tanganyika, studied virus techniques; and Mr. G. A. Atkinson, Colonial Building Research Liaison Officer, studied building research and practice in relation to tropical building and housing.

Colonial Research Publications

23. 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:

Statistics for Colonial Agriculture. Report on the organization of recording and estimating, by K. E. Hunt, Institute of Research in Agriculture Economics, University of Oxford. (Publication No. 11. 7s. 6d. net.)

Insect Infestation of Stored Food Products in Nigeria. Report of a survey carried out during 1948 to 1950 and of control measures adopted. (Publication No. 12. 5s. 0d. net.)

Colonial Research Studies series:

No. 5. Native Administration in Nyasaland, by Lucy Mair, M.A., Ph.D. (2s. 6d. net.)

Mention should also be made of a report entitled " The Processing of Colonial Raw Materials: a Study in Location " by Dr. Charlotte Leubuscher. (H.M.S.O., 10s. 0d. net.)

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)*

24. The African Studies Branch of the Colonial Office is undertaking surveys of particular subjects to meet current Colonial Office needs. A complete survey of the Development of Local Government in the African Territories since 1947 began appearing in the form of supplements to the Journal of African Administration in January, 1952. All publishable material which comes to the notice of the Branch also appears in the Journal which in addition carries digests and notices of important Colonial reports and legislation. The Branch assists in sponsoring publication by H.M.S.O. of important books and reports on African Administration, sometimes in collaboration with the Research Department of the Colonial Office. Two publications, " Systems of Land Registration," by Sheppard and Dowson, and " A Bibliography of Published Sources relating to Land Tenure in South East Asia and the Pacific," are at present printing. It also performs other functions in no way connected with research, such as arranging for training in local government for Africans and for Colonial Service Officers.

25. 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, and through visits by members of the Branch to Africa. In the course of the year the Head of the Branch visited Northern Nigeria, Tanganyika and British Somaliland, and the Senior Research Officer visited Uganda. Another medium for the exchange of information is the Cambridge Summer Conference on African Administration, the organization of which falls to the Branch. A Conference held in August 1951, to discuss local government was attended by 220 representatives, mainly from Africa and the United Kingdom.

26. The Local Government Advisory Panel's Finance Committee made progress in reviewing the problems of financing local authorities in Africa. In response to a questionnaire circulated to certain Colonial Governments, a complete picture of the problem in five of the African territories was built up during the year.

B. *Building Research*

27. Mr. Ian Small, B.Sc., A.M.I.C.E., of the Department of the Civil Engineer-in-Chief, Admiralty, was appointed Director of the West African Building Research Organization, and will proceed to the Gold Coast in the summer of 1952.

28. In February, 1952, the Seventh Conference of West African Directors of Public Works met in Freetown and discussed the recommendation for the establishment of a Building Research Station.

29. The Colonial Building Research Liaison Officer (Mr. G. A. Atkinson, B.A., A.R.I.B.A.) reports that he is receiving an increasing number of enquiries from architects, civil engineers and commercial firms in the Colonial territories. During the year he presented his report on his visit to the Caribbean area in the spring of 1951. This report has been circulated to the Governments concerned. Mr. Atkinson has emphasized the need for the control and guidance of building development in order to prevent the slum conditions which had grown up in the past in many towns, and referred to the pioneer housing work which had taken place in recent years and the standards which are being adopted. He advocated that funds available for housing could very usefully be expended in developing sites and in helping families to build their own houses. (A review of aided self-help

housing, based mainly on information gained during his tour, was subsequently prepared by him and circulated to all Colonial Governments.)

30. Mr. Atkinson also described the main building methods in use in the Caribbean. He found that with the development of local cement manufacture, masonry forms of construction were likely to be used more and more. Nevertheless, timber would still be needed, and the use and marketing of Caribbean timbers was dealt with in a note attached to the report.

31. As regards building research, Mr. Atkinson reached the conclusion that, on account of financial and staffing difficulties, there was little or no possibility of carrying out organized scientific research into building problems in this area, at any rate in the immediate future. However, much could be done to improve building materials by making technical information more readily available, and by providing better facilities for training building technicians and for testing building and civil engineering materials.

32. Mr. Atkinson mentioned the experience in hurricane-resistant construction which had been gained in the United States, and at his suggestion an American engineer, who had made a special study of this problem, visited Jamaica under the auspices of the United States Economic Co-operation Administration shortly after the hurricane of August 1951. Mr. Atkinson prepared a Colonial Building Note No. 7 entitled " Hurricanes and their effects on building."

33. During January to May 1952, Mr. Atkinson visited Hong Kong and the South-East Asian territories, and also Aden and Cyprus. He is preparing a report on this tour, which was the longest he had made. On his way back he returned to Malaya, at the request of the Federation Government, to make a special report on the housing of senior Government officers. This report has been published by the Federation Government. Mr. Atkinson spent six days in Delhi at the invitation of the Government of the Republic of India, and visited some of the principal Government research establishments, including the National Physical Laboratory, the Road Research Laboratory and the Building Research Institute. During his tour he gave eight illustrated talks to various associations of architects and engineers.

34. While in Hong Kong, Mr. Atkinson advised the Government on the revision of the Building Ordinance. A study of the general principles involved in drafting Colonial building regulations has been made by him and will shortly be circulated.

35. Mr. Atkinson has now visited 25 Colonial territories.

36. Other work has included a study of coral rock for use as a building material, the observation of a demonstration cement-earth brick building, erected at the Building Research Station, which shows little signs of deterioration after some two years' exposure, and the study of roofing materials suitable for use overseas. The last-mentioned include a proprietary resin-bonded paper laminate made in the form of a lightweight, corrugated roofing sheet. Specimens of this exposed at the Station show little deterioration, other than loss of surface gloss, after nearly two years. Although this material is comparatively expensive, it is being used in Malaya and elsewhere because it is easy to transport and fix.

37. Technical officers from 17 territories, including the British West Indies, Cyprus, Fiji, Hong Kong, Malaya, and West and East Africa, attended the Building Research Congress held in London in September, 1951, at which a number of papers dealing with tropical building problems were discussed. Opportunity was taken of the presence in London of research workers from the Commonwealth and elsewhere to discuss these problems. Particular attention was given to the extension of studies into the weathering of building materials in different climates, and a working party subsequently prepared a scheme to compare the effect of climatic

factors in different localities on a limited number of typical materials. The " Colonial Building Notes," mentioned in paragraph 33 of last year's report, have been well received. So far seven Notes have been issued on a variety of subjects, including building in no-fines concrete, schools in the West Indies built with soil-cement blocks, and the ventilation of buildings.

38. The following information has been received from Colonial Governments:

(*a*) *Tanganyika.* Attention was paid by the Department of Geological Survey to methods of production of building lime and to the possibility of the introduction of an enforceable standard specification. The Department also continued practical trails of stabilized earth bricks. The erection was begun of a test structure in which only locally-obtainable materials are being used.

(*b*) *Kenya.* Houses on five different types of foundation have been built on black cotton soil and the movement of the buildings is being regularly observed. Much of the best land in Nairobi is already built upon, and areas with depths of ten ft. and more black cotton soil have now to be considered. Removal is uneconomic and other methods are having to be tried.

The swelling and shrinkage of red coffee and black cotton soils is also being studied using the gauges developed by the Building Research Station. In view of the higher temperature prevailing the movement is being studied to a depth of ten feet.

During the year a weathering site has been established at the Meteorological Station for all building materials and paints.

(*c*) *Singapore.* A paper entitled " Singapore experiments on the use of aluminium roof-sheeting," was prepared by Mr. R. J. Hollis-Bee, M.I.C.E., Senior Executive Engineer, Malayan Public Works Service. This paper describes the effect of double aluminium roof-sheeting on a building in the exclusion of solar heat.

(*d*) *Caribbean.* During the year the Caribbean Commission published an important report prepared by the Research Department of its Central Secretariat, entitled " Aspects of Housing in the Caribbean." This contains information regarding materials, aided self-help schemes, endeavours made to cope with overcrowding problems, statistics on housing and disease, relevant legislation and a general analysis of the position.

C. *Colonial Products Advisory Bureau*

39. The work of this organization has not hitherto been included in the Council's report. The Bureau was formerly the Plant and Animal Products Department of the Imperial Institute and was taken over by the Colonial Office in 1949. The Bureau deals with investigations and enquiries relating to all plant and animal products, such as pests, oil seeds, essential oils, fibres, paper-making materials, drugs, tobacco, tanning materials, gums and resins, silk, hides and skins, insecticides, etc., and is assisted by a number of advisory committees on groups of materials. It is under the direction of Dr. J. R. Furlong, A.R.I.C., whose report on its activities for the year under review is annexed as Appendix II.

40. The work of the Bureau covers very much the same field as that of the Colonial Products Research Council, but whereas the latter body is concerned primarily with fundamental research, the Bureau is mainly occupied with *ad hoc* investigations. There is, however, no clear line of demarcation between the two sets of activities, and it is proposed to bring the work of the two bodies under a common Directorship at the beginning of next year.

D. *Demography and Censuses*

41. The publication of Volume III of the "Demographic Survey of the British Colonial Empire" based on material prepared by the late Dr. R. R. Kuczynski, has been delayed, but it is hoped that it will be issued early in 1953.

42. During the year censuses have taken place—for the first time since 1931—in North Borneo and Gibraltar; they were also held in Northern Rhodesia, covering the non-African population and Africans in employment, and in the Gambia. Almost all Colonial territories have now had a census at some time during the past ten years, the most important exception being Nigeria, where a census will start in June, 1952.

43. Studies of population trends have continued on the basis of census and sample surveys carried out during recent years. For example, the Central African Statistical Office has issued provisional estimates of African birth, death and infant mortality rates in Northern Rhodesia*, and estimates of birth and death rates in certain areas of East Africa have been made by the Statistical Department of the East Africa High Commission. The Vital Statistics Officer of the Development and Welfare Organization in the West Indies has published population projections by broad-age groups, covering the next decade†. An officer of the Malayan Civil Service who held a Commonwealth Fund Civil Service Fellowship in 1949–50 has made an analysis of recent population trends from the 1947 census results.‡

E. *Geodetic and Topographical Surveys*

44. The Directorate of Colonial (Geodetic and Topographic) Surveys moved into new Headquarters at Tolworth in June, 1951.

45. Little more progress has been made in recruitment of field survey staff but the cartographic establishment was brought up to strength by recruiting direct from schools.

46. One party of field surveyors, including three Americans recruited by E.C.A., has been engaged upon geodetic triangulation. This party has reconnoitred, beaconed and observed a chain of triangles from Eastern Uganda (near Mount Elgon) down the east side of Lake Victoria to Tanganyika. In addition a base was measured near Kisumu.

47. Geodetic triangulation has continued in Basutoland and most of the southern half of the territory has also been covered with secondary triangulation. Secondary and minor triangulation and fixation of control for mapping from air-photographs has also continued in Kenya (areas of forestry and geological interest, also an area where radar accuracy is being tested), Tanganyika and Northern Rhodesia (areas concerned in the proposed rail-link, in the Copper Belt and for Red Locust control). A party moved to the Gold Coast and recommenced work in the Volta River area in April. Work has continued, mainly astronomical fixes, in British Guiana. One surveyor is at work in St. Vincent.

48. The Royal Air Force continued air-photography in Central and East Africa. Less spectacular progress was made this season since the programme consisted mainly of gap filling in areas where weather is usually bad. R.A.F. photography

* Northern Rhodesia Economic and Statistical Bulletin, June 1951, published by Central African Statistical Office, Salisbury.

† Caribbean Economic Review, October 1951, published by the Caribbean Commission, Trinidad.

‡ Population Growth in Malaya, by T. E. Smith, published by Royal Institute of International Affairs, 1951.

also continued in Malaya, North Borneo and Sarawak. Commercial contracts were placed for air-photography in Fiji, Bechuanaland and Gold Coast.

49. Mapping has been continued under pressure, although the move in June caused a temporary setback in production. Two hundred and forty-one preliminary plots have been published at scale 1:50,000 covering areas in Gold Coast, Uganda, Kenya, Tanganyika, Nyasaland, Northern Rhodesia, Basutoland, Swaziland, and North Borneo. This represents an area of over 70,000 square miles. In addition maps at large scales have been published of town areas in North Borneo and Sierra Leone. Planimetric mapping of Mauritius has been completed at scale 1:25,000 and the maps are now being printed. Preliminary work has commenced on large areas in Nigeria, British Guiana, Somaliland, and Gold Coast. Small scale mapping has continued in the Falkland Islands Dependencies and a number of miscellaneous maps for special purposes has also been produced. Drawing and publication of maps for the Directorate of Colonial Geological Surveys is now an established practice.

F. *Geological Surveys*

50. An additional 20 geologists were appointed during the year to the Geological Surveys of Nigeria, Kenya, Tanganyika, British Guiana, Malaya, Fiji, and Cyprus, and the planned expansion of the Colonial Geological Surveys is now approaching completion. The strength of the overseas scientific staff was 180 in 1951 compared with 58 in 1947. There is still a shortage of experienced geologists with training in mapping, petrology and mineralogy fitting them specially for work in Colonial territories, and all Surveys, therefore, are somewhat short of men who can help with the training of the recruits.

51. British Guiana has extended the secondment of the Senior Geologist to British Honduras until the year 1955 to continue his examination of part of their Colony, and a mining organization has sent a party to examine areas selected by him as possibly containing minerals in economic quantity. British Guiana have also seconded a geologist to work for three years in the Leeward Islands, and a similar secondment to the Windward Islands is being made. These officers will co-operate with a seismologist who is shortly to take up his duties collecting data in the islands of the Antilles Arc, which, it is hoped, will lead to the prediction of volcanic eruptions. A geologist seconded from Nigeria has continued his work in the Aden Protectorate where he has been examining the problem of water supplies, and Dr. Shaw, a Deputy Director of the Directorate of London, has paid a visit there to assist with geophysical investigations. Additions to the strength of the new Geological Survey in Northern Rhodesia have been made. The Senior Geologist in the Solomon Islands Protectorate has established the likelihood that minerals occur there in economic quantity and a mining company has sent a prospecting party to investigate. Two additional geologists are to work in the Solomon Islands. The work of the Senior Geologist in Cyprus has shown that an increase in staff is needed there also to carry out detailed geological mapping in mineralized areas; one additional geologist is already at work and another will be appointed shortly. A small new Geological Survey has been established in Fiji, under a Senior Geologist who has recently assumed duty.

52. The political situation in Malaya has hindered field operations except in a few areas and this is particularly unfortunate in view of the depletion of tin reserves. Two geologists are being seconded to serve for one year in the Solomons. As in other Departments, some of the staff of the Geological Survey have helped with the scheme for the resettlement of squatters. The Government of Hong Kong has in the press an account of the geology and mineral resources of the territory illustrated by a geological map. A Chief Geologist has been appointed to take charge

of a new Geological Survey Department in the Somaliland Protectorate and will shortly take up duty there; he will be assisted by three geologists.

53. The 16 experienced American and Canadian geologists, chemists and mining engineers who were attached to the Geological Surveys of Nigeria, Gold Coast, Sierra Leone, Uganda, Kenya, Tanganyika, Nyasaland, and British Guiana under an Economic Co-operation Administration Scheme continued to give valuable help, and a short-term investigation by a chemist of the United States Geological Survey on the lead-zinc deposits of the Abakiliki region in Nigeria gave interesting results. The object of this research was to test the possibilities of a geochemical method of prospecting which had been initiated there several years earlier by geologists from the Royal School of Mines, London. Under another Economic Co-operation Administration Scheme an engineer and a geologist from the U.S.A. were sent to Malaya to advise on the feasibility of constructing a high dam across a stream where the presence of a huge quartz reef had made it difficult to guarantee that a reasonably water-tight reservoir could be made. They were able to give a favourable verdict.

54. The increase in staff in most Geological Surveys has enabled a corresponding increase to be made in the total area geologically mapped during the year, and continued progress has also been made in the investigation of a number of mineral deposits, and of various research projects, of which only the following need be mentioned. In Nigeria routine examinations of occurrences of coal, lignite, limestone, clays, iron ores and lead-zinc ore-bodies have been made, and field parties have carried out research on the palaeontology of the Nigerian Cretaceous and Tertiary, the stratigraphy and structure of the Gongola Valley, the palaeobotany of coals and lignites, and, as above mentioned, on the feasibility of prospecting by geochemical methods for concealed lead-zinc ore-bodies. A laboratory study was made of the de-magnetization of magnetic cassiterite by heat treatment and of how the process could be used to simplify the methods now in vogue of producing tin and columbite concentrates. There are indications that two new gold ore bodies have been found by the Gold Coast Geological Survey in the Prestea goldfield, and a promising gold-bearing quartz vein has been found in the Tonkoliki District of Sierra Leone.

55. Research continues at various institutions in the United Kingdom on the problem of economically producing columbian minerals, iron ore and apatite from the soils surrounding the Sukulu carbonatite ring-structure in Uganda. The recently established Mineral Resources (Research) Committee of the Government of Uganda has also done much experimental work in East Africa, most of it in close association with the Uganda Department of Geological Survey. In addition the Committee has built its own special chemical laboratory, where work will shortly begin, and a pilot scale ore-dressing laboratory is also being set up. Furthermore, work on behalf of the Committee is undertaken at the East African Scientific and Industrial Research laboratories in Nairobi, including the investigation of raw materials for cement manufacture, and the testing of refractories. Ore-dressing work in connection with the development of the Tororo mineral deposits has also been undertaken at the laboratories of the Tanganyika Geological Survey. Drilling has shown that the Sukulu deposits of Uganda contain several million tons each of apatite and magnetite, together with many thousands of tons of pyrochlore. In the Busumbu and adjacent areas a fairly extensive pitting programme was undertaken to ascertain the extent of known deposits of vermiculite. An extensive new deposit of graphite is being investigated in Kenya, where also there are possibilities of increasing the production of kyanite. Laboratory research has been conducted there on the development of a process for treating anthophyllite asbestos found in a prospect in the Teita Hills and samples have attracted favourable attention both from the U.S.A. and from Europe. Research has continued into the methods of

treating graphite ore with a view to extracting the maximum quantity of graphite with a minimum of damage to the larger flakes. A number of tests have been made on the recovery of kyanite from kyanite-bearing schists, and investigation continues into possible methods of improving the filtering capacity of local diatomite.

56. Good progress is being made in the examination of coalfields in Tanganyika by the Geological Survey, and tests have been made on the suitability of local coal for industrial use. Other activities of the Geological Survey have included the following. The methods of treating gold ores have been studied, with a view to reducing costs and to increasing extraction and output. An experimental new process was devised for the recovery of diamonds from alluvial ground which may provide a significant contribution to this problem. The activities of the new Bechuanaland Geological Survey have already led to the export of kyanite and asbestos, and a geophysical examination has been made of the old Bushman Copper Mine; an investigation of coal, iron ore and other minerals is in hand. Swaziland produced valuable amounts of asbestos, gold cassiterite and barytes. There is now a definite prospect of producing columbite from the Morabisi area of British Guiana. In several Colonies the raw materials for cement manufacture have been proved, and geological work has been undertaken in connection with great engineering schemes; geophysical methods and the use of aerial photographs continue to afford their help in geological investigation. Much successful work was done in finding water supplies.

57. The Second Conference of West African Geological Surveys was held at Jos, Nigeria, and was attended by delegates from French West Africa. The Fourth East African Inter-Territorial Geological Conference was held in Entebbe. Both were attended by Dr. F. Dixey, the Secretary of State's Geological Adviser and Director of Colonial Geological Surveys. The Second International Conference of the Geological Surveys of the British, French and Dutch Guianas was held, this time in French Guiana. A conference of geophysicists in Nairobi was attended by Dr. Shaw.

58. The interest taken by the Universities in Colonial Geology continues to grow and is manifested in practical and useful ways. Professor W. Q. Kennedy of the University of Leeds with Dr. McConnell of the Uganda Geological Survey led a scientific expedition to the Ruwenzori Mountains, and the party included also other geologists from the University of Leeds and one from Oxford. A second expedition to Ruwenzori is planned for this year. Leeds University is also helping further by investigating the amount of columbium in the bauxite of Mlanje, Nyasaland. Professor C. E. Tilley, Head of the Department of Petrology and Mineralogy, Cambridge, spent two months in Nyasaland examining occurrences of corundum and other minerals, and one of his staff spent some weeks on Ascension Island investigating the deep sub-oceanic rock fragments which had been brought up by volcanic eruptions. A member of the staff of St. Andrew's University is going to do petrological work on rocks from British Guiana. Professor C. E. Marshall of Sydney University led a party of geologists in the British Solomon Islands. A geologist from Cape Town University collected specimens in Bechuanaland and Swaziland with a view to doing research in the United States on their age by the method of spectrographic determination of isotopes. A student from Cape Town plans to do research in Jamaica, and another from Johannesburg proposes to work similarly in Swaziland. A student from the Royal School of Mines, London, was employed in Uganda by the Geological Survey for the period of his long vacation.

59. Work carried out by the Photogeological Section of the Directorate of Colonial Geological Surveys included the making of a reconnaissance photo-geological map of 3,500 square miles of Western Sarawak on a scale of two miles

to an inch. A further area of 10,000 square miles is to be examined. Work was done also for the British Solomon Islands Protectorate, for Uganda, Nyasaland, Tanganyika, Bechuanaland, and Northern Rhodesia.

60. Visits were made by the Secretary of State's Geological Adviser to the East African territories, to South Africa and to Cyprus. He also attended meetings of the International Association of Scientific Hydrology at Brussels and read a paper on " Subterranean Water Supply Investigations in the British Colonies." He contributed to the United Nations Symposium on Arid Zones Research a paper on " Water Deficiency Areas and Arid Zones in the British Colonies." Other members of the Directorate and of the Mineral Resources Division visited St. Helena, Uganda, Nyasaland, Cyprus, and Aden in order to assist with the examination of mineral deposits by geological and geophysical methods and to investigate water supplies. The Mineral Resources Division of the Directorate continued its investigations on samples received from Colonial Territories, dealt with a large number of technical enquiries, published numbers of its Quarterly Bulletin " Colonial Geology and Mineral Resources," and prepared an Annual Summary of Mineral Statistics and publications on various minerals.

G. *Industrial and Engineering Research*

61. Industrial research is mainly covered by the report of the Colonial Products Research Council and the following paragraphs contain information provided by Colonial Governments which is not recorded in that report.

62. In Uganda detailed experimental investigations were undertaken by the British Paper and Board Industry Research Association on the suitability of various local fibres for incorporation in a pulp for the manufacture of a kraft-type paper for use as a material from which containers can be made, primarily for the cement and sugar industries. Preliminary reports indicate that one or two of these fibres show considerable promise.

63. A number of small *ad hoc* investigations were carried out by the Chemical Laboratory at Dar-es-Salaam in Tanganyika. These included the preparation of a ghee substitute from beef fat and coconut oil, the examination of local methods for refining crude cotton seed oil with a view to the production of a cheap edible oil, the treatment with soda ash of the crude salt used in the curing of hides, experiments to gauge the yield and quality of starch extracted from cassava and the working out of analytical constants of Trigona wax.

64. A paper entitled " Some notes on the durability of paint in tropical climates " was prepared by Mr. R. J. Hollis-Bee, M.I.C.E., Senior Executive Officer, Malayan Public Works Service, with particular reference to the humid tropical climate of Singapore. In the paper the breakdown of paint films due to loss of gloss, fading and chalking, cracking and biological attack are described and remedies suggested.

65. The Crown Agents for the Colonies report that their Engineering Advisory Service has continued to be closely engaged in activities connected with the retention of the services of consultants and specialists required to advise Colonial Governments on engineering and architectural schemes. A considerable number of requests from Colonial Governments for arrangements to be made for officers to attend technical study courses in the United Kingdom whilst on leave have been met. Much interest was shown in recent developments of prestressed concrete.

66. Contributions to the " Crown Agents Review " have included the tropic proofing of materials, the standardization of products for Colonial use, developments on the manufacture of higher tensile steel chain and a second note on the work of the Mechanical Engineering Research Organization.

H. *Meteorology*

67. As in previous years the main preoccupation has been the development of the Colonial meteorological services. The First Congress of the World Meteorological Organization, held in Paris during March and April, 1951, established six Regional Associations of the Organization. The Congress was attended by delegates from various Colonies and, as a result, Bermuda, the West African territories, the Central African territories, the East African territories, Indian Ocean islands, Hong Kong, and the Malayan and Borneo territories, have each joined the appropriate Regional Association of the Organization. Following the recommendation of a conference in January, 1951, of representatives of the West Indian Colonies, the headquarters of the British Caribbean Meteorological Service were set up in Trinidad in October, 1951; and it is expected that in the near future the West Indian Colonies will apply for membership of the World Meteorological Organization.

68. Progress has also continued in the installation of radio sonde/radar wind stations for the study of upper wind conditions. Stations making regular observations to a height of 60,000 feet are now established at Aden, Gibraltar, Lagos, Malta, and Nairobi. Consideration is being given to the installation of similar facilities at Hong Kong and Singapore. Meteorological research by the Falkland Islands Dependencies Survey has continued and included the study of ionospherics in co-operation with the Department of Scientific and Industrial Research.

69. A report dealing with " Experiments at Kongwa (Tanganyika) on artificial stimulation of rain, January to April 1951," by Messrs. D. A. Davies, D. Hepburn, and H. W. Sansom, was published during the year.* Several enquiries were received by the Colonial Office from Colonial Governments regarding the possibilities of artificial rainmaking, and, after reference to the Meteorological Office of the Air Ministry and other authorities, statements were sent to them giving such conclusions as it had been able to draw from experiments carried out in various parts of the world into this problematical field.

70. There was also published a note by Mr. D. A. Davies on " The Climate of Kenya in relation to the cultivation of Ramie."† " A Statistical Survey of Typhoons and Tropical Depressions in the Western Pacific and China Sea areas," by Mr. L. Starbuck, was also published during the year‡, as was a publication on " Hong Kong Typhoons," by Mr. G. S. P. Heywood§.

71. The undermentioned papers by members of the Malayan Meteorological Service have been published:—

" The Equatorial Convergence Lines of the Malayan–East Indies Area," by I. E. M. Watts.

" The Properties of the Upper Air over Singapore," by I. G. John.

" The Development of Horizontal Divergence and Vorticity in the Low Latitude Atmosphere," by J. R. Scott.

I. *Oceanography*

72. An annual contribution is made by the Colonial Office towards the work of the National Oceanographic Council. The Council's report for 1950–51 (Cambridge University Press: 5s. 0d.) describes continued research on waves and

* East Africa High Commission, Meteorological Department. Memoirs, Volume 11, No. 9, 1951.

† East Africa High Commission, Meteorological Department. Memoirs, Volume 11, No. 8, 1951.

‡ Hong Kong Royal Observatory. Technical Memoir, No. 4.

§ Hong Kong Royal Observatory. Technical Memoir, No. 3.

swell and on the factors which govern the energy exchange between the atmosphere and oceans. One of the main objects is to obtain precise information about the processes which cause fluctuations in the physical and chemical properties and movements of the water in order to further our understanding of their effect on the fish populations. A number of new instruments are being developed; one of them, not mentioned in the report, was a simple method of recording the changes in depth of a mid-water trawl, by measuring the changes in pressure in a rubber bag attached to the trawl and connected to the ship by a reinforced hose pipe. It was devised for the Fisheries Adviser to the Colonial Office, and when tried in the Thames Estuary it allowed the depth of the trawl to be adjusted as accurately as was desired.

73. The R.R.S. "William Scoresby" during a whale-marking voyage discovered the breeding ground of the pilchard (*Sardinops sagax*) which forms the basis of the modern South African fish canning industry; detailed information has been supplied to Colonial fishery officers in West Africa. Oceanographical data from the Benguela current are being used in a study of the factors which cause great differences in productivity between different oceanic regions. The R.R.S. "Discovery II" returned to England after completing an oceanographical survey of the Southern Ocean. Research on whales and the distribution of whale food has been actively continued and Dr. Mackintosh attended the meetings of the International Whaling Commission as Scientific Adviser.

74. Full development of the Institute's activities has been delayed by the difficulty of acquiring premises in which the scientific and administrative staffs can be accommodated, but a number of young men specializing in the various branches of science are making good progress towards applying their specialist knowledge to some of the outstanding problems of marine science.

J. *Road Research*

75. The work of the Colonial Liaison Officer at the Road Research Laboratory of the Department of Scientific and Industrial Research (Mr. H. W. W. Pollitt) is attracting increasing attention from Colonial engineers, and many of them have visited the Laboratory. Two of them worked at the Laboratory as voluntary workers for two months, and two others for shorter periods. The volume of correspondence from the Colonies has also increased.

76. During October and November 1951, the Liaison Officer went to Northern Rhodesia and Nyasaland to see the roads and road problems there. Through the courtesy of the Government of Southern Rhodesia, that territory was also visited to seek information of value to the territories which he serves. A report is being prepared. Broadly speaking, the same problems were met in Central as in East and West Africa, though the soils there appear to present less difficulty than those in East Africa.

77. A paper on "The Need for Colonial Road Research" has been written for the 1952 Conference on Civil Engineering Problems in the Colonies. Assistance has also been given in planning and analyzing data for a round table conference of Colonial highway engineers to be held after the main Conference.

78. Owing chiefly to lack of staff and equipment, there has been little progress in studies of soil moisture movements by Colonial Public Works Departments. The Laboratory is, however, in close touch with work in the Dominions on this important problem.

79. Research on the properties of black cotton soils has continued with the co-operation of the Rothamsted Experimental Station and the Macaulay Institute

for Soil Research. The predominant clay mineral in five cotton soils from Africa and India was found to be montmorillonite, whose structure permits the taking up of water between the crystal lattice layers with consequent marked volume changes. The addition of hydrated lime materially reduced the plasticity and volume change properties of a cotton soil, while increasing its strength. Lime and " wood-tar " used together were found to have a marked waterproofing effect on cotton soil.

80. Routine tests on Colonial soils and aggregates have continued and reports issued during the year made recommendations in connection with sand-bitumen carpet experiments in the Gambia, and the use of local aggregates for marine and other concrete structures in North Borneo.

81. Following a suggestion by the Laboratory, field experiments have been made in Nigeria on the production of low grade aggregate by burning cotton soil. The experiments are reported to show promise and are understood to be continuing.

K. *Water Pollution Research*

82. Contact has been maintained between the Water Pollution Research Laboratory and the official correspondents nominated by Colonial Governments. Enquiries have been received from Kenya and the Gold Coast; information has been provided on methods for removing fluorine from water, on methods for treating waste waters from the processing of coffee and sisal, and on the suitability of the activated-sludge process for treatment of sewage in tropical countries.

83. At the request of the Government of Uganda, the Director of the Laboratory visited that territory and advised on measures to be taken to safeguard the purity of water supplies and of waters containing fisheries. Among the polluting liquors for which, it is expected, treatment will have to be provided during the next few years are drainage from copper mining operations, domestic sewage, and effluents from a textile mill, and other factories which may be built on the Victoria Nile.

APPENDIX I

Table I

LIST OF SCHEMES APPROVED FOR RESEARCH GRANTS UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS DURING THE PERIOD 1ST APRIL, 1951, TO 31ST MARCH, 1952

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
461 461A	**General**	Insecticides research. Development of a scanning device for the automatic assessment of spray deposits. (This research is being carried out under the auspices of the Sprayers Sub-Committee of the Insecticides Research and Development Committee of the Agricultural Research Council: the grant represents approximately one-third of the estimated cost.)	1,235
379A	do.	Research at the Lister Institute of Preventive Medicine into the preparation of precipitin sera for entomological investigations of malaria, trypanosomiasis, etc. (to cover three years' further work).	8,270
238B	do.	Provision for continuation of work of the Colonial Building Research Liaison Officer and staff for a further period of 3 years (supplementary provision).	21,750
296A	do.	Appointment of a Tropical Soils Adviser at the Rothamsted Experimental Station (supplementary provision).	1,500
47E	do.	Publication of the late Dr. R. R. Kuczynski's Demographic Survey of the British Colonial Empire (supplementary provision).	600
464	do.	Establishment of a training centre for ecologists selected for work in Colonial territories: provision for training in the United Kingdom (3years) (in continuation of Scheme R.396).	4,860
420A	do.	Mechanical production of jute and jute substitute fibres (supplementary provision for personnel and equipment).	5,300
376A	do.	Production and publication of reports in the "Colonial Fisheries Research" series (supplementary provision).	2,000
97B	do.	Appointment of Secretary, Colonial Social Science Research Council (supplementary provision).	460

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
76D	**General**	Appointment of Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research (supplementary provision).	1,760
465	do.	Establishment of a training centre for ecologists selected for work in Colonial territories: provision for training overseas (3½ years) (in continuation of Scheme R.396).	34,000
466	do.	Establishment of a Colonial Pool of Plant Pathologists at the Commonwealth Mucological Institute (4½ years).	14,000
476	do.	Purchase of rotary brush spraying equipment for use in dissemination of insecticides from aircraft.	300
479	do.	Provision for purchase of separata of scientific articles written by officers employed under Colonial Development and Welfare Research schemes and published in scientific journals (4½ years).	100
247D	do.	Contribution towards maintenance of the Common Services Section of the British Commonwealth Scientific Offices, London, during the year 1952/53.	350
481	do.	Fisheries research. Making of photo-electric apparatus to determine phosphates and other trace elements in sea water.	120
494	do.	Anti-Locust Research Centre and its extra-mural research. Provision for year 1952/53. (This scheme entails the winding up of Schemes R.51B and R.447.)	28,750
131B	do.	Appointment of a Joint Secretary of the Colonial Medical Research Committee. Provision for period 1952/53 to 1955/56.	9,000
28G	**Africa, General**	Preparation of the Handbook of African Languages (expenditure for quarter ending 31.8.1951).	360
28H	do.	Preparation of the Handbook of African Languages: provision for year ending 31.5.52.	3,510
216E	do.	Study by Miss Kellas of the reproductive cycle in African ungulates (supplementary provision).	575
457	do.	Survey of Animal Breeding policy and research in African territories.	2,000

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
463	**Africa, General**	Grant to assist publication of a monograph on the African species of Phlebotomus, by Drs. R. Kirk and D. J. Lewis.	200
472	do.	Survey of the literature on African fauna.	2,200
487	do.	Visits by members of Colonial Medical Research Committee to East and West Africa (4 years).	8,300
470	**East Africa, General**	Experiments in East Africa in the dissemination of insecticides from fixed-wing aircraft.	15,400
222A 222B	do.	Study of Arthropod Fauna of tropical soils by Dr. G. Salt (supplementary provision).	24
474	do.	Hiring and equipping of aircraft for dissemination of insecticides in East Africa.	25,000
482	do.	Further research by Dr. G. A. Walton into relapsing fever in East Africa (4½ years).	23,000
438A	do.	Research at Lister Institute of Preventive Medicine into the preparation of precipitin sera for entomological investigations of malaria, trypanosomiasis, etc.: expenditure on collecting work in East Africa (supplementary provision).	420
489	do.	Anti-locust research. Small scale air spraying trials against flying swarms of desert locusts in East Africa.	9,300
491	do.	Pilot schemes for reclamation of tsetse infested land in Kenya, Uganda and Tanganyika (4 years). (In addition to the above grant, £130,000 is being made available from the Colonial Development and Welfare funds set aside as a reserve for African development schemes, and expenditure of the order of £340,000 for the maintenance and development of cleared areas is contemplated by the three Governments from their own resources.)	70,000
144A	do.	Physiological and biochemical research at Makerere College, Uganda. (Grant is to provide for continuance of the work from 1.1.1952 to 31.3.1956.)	31,500
354C	do.	Desert Locust Survey. Contribution towards maintenance during calendar year 1952.	11,373

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
392A	**East Africa, General**	East African Marine Fisheries Survey (supplementary provision).	1,650
153C	do.	East African Agriculture and Forestry Research Organization. Supplementary grant towards recurrent expenditure for period ending 31.12.1952. (Grant represents one-half of the total estimated requirement: the other moiety is being defrayed by the East African Governments.)	26,620
488	**East Africa and Mauritius**	Insecticides research. Visit to East Africa and Mauritius of Dr. G. Giglioli, Malariologist to the Government of British Guiana.	200
467	**Kenya**	Medical research. Assistance towards cost of reproduction of X-ray plates to illustrate a report by Dr. D. H. Mackay, Kenya Medical Service, on the skeletal maturation of the African.	110
252C	do.	Sociological research in Kenya by Mr. P. H. Gulliver (supplementary provision).	338
432A	**Tanganyika** ...	Studies in Tanganyika by Mr. B. W. Thompson on micro-climates in connection with the dissemination of insecticides (supplementary provision).	643
425A	do.	Sociological study by Mr. G. M. Wilson of the Barabaig people of Tanganyika (supplementary provision).	285
134C	**Zanzibar**	Clove research, Zanzibar: grant to enable work to be extended until 31st August, 1953. (The cost of the plantation on which the experiments will be carried out and certain other expenditure, estimated in all at £4,600 will be met from local sources.)	17,500
492	**East and Central Africa**	Economic survey of the structure and organization of the distributive industries of Tanganyika and Nyasaland. (The cost of this survey is estimated at £3,320. The Tanganyika Government has agreed to contribute £1,350 and the Nyasaland Government £600. The scheme cancels and replaces Scheme R.449 made in 1950.)	1,370

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
223B	**East and Central Africa**	Ecological survey in Northern Rhodesia and Tanganyika by Mr. C. G. T. Morison and other scientists (supplementary provision).	108
345A	**Northern Rhodesia**	Sociological research in Northern Rhodesia by Mr. A. L. Epstein (supplementary provision).	313
477	do.	Research by Professor John G. Matthyse into control of ticks affecting livestock in Northern Rhodesia.	3,200
478	do.	Sociological research in Northern Rhodesia by Mr. M. G. Marwick.	300
453	**West Africa, General**	Grant towards expenses of two University students to be selected to visit and work at the West African Fisheries Research Institute during 1951.	275
456	do.	Visit by Mr. C. Bloomfield, Rothamsted Experimental Station, to West Africa to study laterite soil problems.	300
468	do.	Establishment of the West African Institute of Social and Economic Research: estimated capital and recurrent expenditure during the period 1.7.1951 to 31.3.1956. (This sum is partly offset by a reduction of £32,000 in the grants made under Schemes R.326 and 326A.)	97,220
471	do.	Research into incidence of maize rust in West Africa. (Grant represents £8,500 in respect of capital expenditure, and £26,000 in respect of one-half of recurrent expenditure over 4½ years, the other moiety being provided by the West African Governments.)	34,500
484	do.	Survey of West African Medical Research by Colonel H. W. Mulligan. (Grant represents 50% of the estimated cost: the other moiety is being defrayed by the West African Governments.)	550
300A	do.	Establishment of a West African Rice Research Station at Rokupr, Sierra Leone (supplementary provision for 4½ years). (Grant covers £35,428 in respect of capital expenditure and approximately £35,100 in respect of one-half of the estimated recurrent expenditure: the other moiety is being defrayed by the West African Governments.)	70,600

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
352A	**Gambia**	Sociological research in the Gambia by Mr. D. P. Gamble (supplementary provision).	466
459 459A	do.	Investigation by Dr. R. A. Webb into micro-fertility of soils in the Gambia (3 years). (Grant represents somewhat under 50% of the total estimated cost of the investigation—the balance is being contributed by the Gambia Government).	6,773
180(*b*)A	do.	Nutrition Field Station, Fajara, Gambia (supplementary provision).	24,403
490	do.	Sociological research. Study by Mr. D. P. Gamble of the Fulla and Serahuli tribes in the Gambia (2¾ years). (Grant represents four-fifths of the total estimated cost: the balance will be defrayed by the Gambia Government.)	3,280
469	**Gold Coast** ...	Malaria research in the Gold Coast by Dr. R. C. Muirhead Thomson (2½ years).	7,150
426A	**Nigeria**	Research by Dr. Barnicot at the Hot Climate Physiological Research Laboratory in Nigeria (supplementary provision).	50
458 458A 458B	do.	Investigation by expert nominated by the United States Economic Co-operation Administration (Dr. O. J. Webster, University of Nebraska) into the breeding of improved grain sorghums and maize in Nigeria. (Grant is to cover estimated sterling expenditure involved.)	1,700
460	do.	Investigation of endemic goitre in Nigeria by Dr. Dagmar Wilson. (The major part of the cost of this investigation is being defrayed from other sources.)	100
421A	do.	Mechanical production of jute and jute substitutes in Nigeria (supplementary provision).	3,800
320B	do.	Sociological research in Nigeria by Mr. E. W. Ardener (supplementary provision).	807
410A	do.	Investigation by Professor G. Walker into transport economies in Nigeria. (One-half of supplementary expenditure: the other moiety is being defrayed by the Nigerian Government.)	50
109D	do.	Hot climate physiological research in Nigeria. Provision for year 1952/53.	8,650

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
485	**Indian Ocean, Seychelles**	Investigation by Mr. D. Vesey-Fitzgerald and Mr. E. S. Brown into the infestation of coconuts by Melittomma insulare in the Seychelles. (The total estimated cost of these visits is £2,256; the balance of which is being defrayed by the Seychelles Government.)	1,325
455 455A	**South-East Asia, Federation of Malaya**	Establishment of a Veterinary Research Laboratory and ancillary facilities in the Federation of Malaya. (Grant is a contribution towards the capital expenditure: any balance of capital expenditure and the whole of the recurrent expenditure will be defrayed by the Government of the Federation of Malaya.)	95,000
177E	do.	Continuation of research by the Scrub Typhus Unit in Malaya until 31.12.1953. (Grant represents one-half of the estimated cost: the other moiety is being defrayed by the Federation of Malaya Government.)	8,200
475 475A	**North Borneo** ...	Re-establishment of the Herbarium at Sandakan, North Borneo, and appointment of a Botanist (4 years).	22,083
321B	do.	Sociological research in North Borneo by Miss M. Glyn-Jones (supplementary provision).	200
483	**Sarawak** ...	Socio-economic survey of Malaya in Sarawak. (This grant is chiefly for capital expenditure. The salaries of the staff and cost of transport are being defrayed by the Government of Sarawak.)	700
270G	do.	Sociological research in Sarawak by Mr. J. D. Freeman (supplementary provision).	500
480	**Hong Kong** ...	Establishment of a Fisheries Research Unit at the University of Hong Kong (4½ years). (Grant is to cover capital expenditure (£31,000) and recurrent expenditure, other than personal emoluments which are being defrayed from a grant made by the Hong Kong Government. The making of this scheme cancels the original scheme R.282 on which there will be a saving of £134,886.)	38,000
206D	**Western Pacific, Fiji**	Linguistic research in Fiji by G. B. Milner (supplementary provision).	340

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
5E	**West Indies and Caribbean, General**	Low Temperature Research Station at the Imperial College of Tropical Agriculture in Trinidad (supplementary provision).	100
486	do.	Visit of Dr. Norman Wright, Chairman of the Committee for Colonial Agricultural, Animal Health and Forestry Research to the West Indies.	400
441A	**British Guiana...**	Study by Miss A. J. Butt of the Arecuna and Akowoio peoples of British Guiana (supplementary provision).	125
454	do.	Grant to assist research into the control of leaf scald disease of sugar in British Guiana (2 years). (Grant represents approximately one-third of the estimated expenditure: the other two-thirds is being defrayed by the British Guiana Government and the British Guiana sugar industry.)	3,100
473	**British Honduras**	Ecological Land Use Survey in British Honduras (3 years).	21,000
231A	**Windward and Leeward Islands**	Seismic investigations in the Windward and Leeward Islands. Employment of Dr. Willmore (supplementary provision.)	700
462	do.	Investigation of seismic activity in the Windward and Leeward Islands. Equipment and maintenance of eight observing stations (5 years).	19,300
493	do.	Visit to St. Lucia by Dr. Gunnar Bodvarsson, Geothermal Department of the State Electricity Authority of Iceland, to investigate feasibility of harnessing energy derived from volcanic fumeroles for the generation of electricity.	50
350B	**Trinidad** ...	Malaria research in Trinidad by Mr. R. A. Senior White (for year 1952).	6,900
		TOTAL	£868,851

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*

* These figures include expenditure totalling £127,423 incurred up to the 31st March, 1952, 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, 1940–1952

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
Total	£5,492,610

APPENDIX II

Colonial Products Advisory Bureau Report of the Director for 1951/52

CONTENTS

Colonial Products Advisory Bureau Report of the Director for 1951/52

INTRODUCTORY

The Bureau was formerly the Plant and Animal Products Department of the Imperial Institute, and was transferred to the control of the Colonial Office on the 1st April, 1949. The main purpose of the Bureau is to promote the industrial utilization of the plant and animal products of Colonial territories. With this object in view the Bureau provides a laboratory and intelligence service. The examination includes chemical investigation and technical trials, and information is furnished relating to sources of raw materials, cultural conditions, methods of production, uses, marketing of the products, and their position on the world markets. The library of the Imperial Institute was placed under the control of the Bureau at the transfer in 1949, and provides the literature, documents, reports and journals required in the work of the Bureau.

2. Association with the manufacturing and consuming industries in the United Kingdom is maintained by a series of Consultative Committees. Each committee, consisting of trade members and representatives of interested organizations, deals with a group of materials, on which they advise the Bureau concerning the advancement of producing industries in Colonial countries, submitting recommendations for new developments, and for improvements in the standards of existing produce.

GENERAL

3. During the year under review 82 laboratory investigations were completed, and the number of inquiries dealt with was 801.

4. It is not proposed to record the inquiries in this report, beyond mentioning that the principal ones concerned comprehensive studies of the market for citrus fruit and products, shark products and papain.

5. The most important investigations and research carried out during the year are briefly recorded in the following section.

6. Reports and papers were published in the Bureau's journal "Colonial Plant and Animal Products," and in other scientific journals.

7. Meetings of the following Consultative Committees were held: Essential Oils (2), Gums and Resins (2), Tanning Materials (1), Hides and Skins (1), Insecticide Sub-Committee on Analysis (5), Vegetable Fibres (1) and Silk Sub-Committee (1).

Chemical and Technical Research

VEGETABLE INSECTICIDES

8. *Pyrethrum.* The work in connection with international methods for the evaluation of pyrethrum was continued, and research was also carried out on standard dilute solutions of pyrethrum for use in biological assays, and on the storage performance of the flowers in powder form. A series of chemical analyses and biological trials was commenced in co-operation with Rothamsted, on new strains of pyrethrum flowers which have been developed in Kenya. The investigation is of the utmost significance as it is necessary to correlate the increased pyrethrin content of these strains with their insecticidal activity. A number of firms in the United Kingdom, and in the U.S.A., are collaborating in this work. A visit was made to the United States by a member of the staff for the purpose of studying the requirements of the pyrethrum-consuming industry in that country, the chief market for the Kenya flowers.

9. The analysis of pyrethrum suffers from the difficulty of separating the several active principles which impart the insecticidal activity. The importance of applying chromatographic methods of separation has been recognised, and research in this connection has been carried out jointly with Rothamsted. Pyrethrins I and II have been separated on both alumina and silica columns. On alumina columns there is some evidence of the separation of the cinerins from the pyrethrins. Material separated in this way has been used to elucidate separations obtained by chromatography of pyrethrum extracts on paper impregnated with alumina, and by paper chromatography of 2 : 4 dinitrophenyl hydrazine derivatives of the pyrethrins.

10. Work on two new vegetable insecticides, chemical and biological, in conjunction with Rothamsted, is in hand. These materials are (1) roots of *Heliopsis scabra* and *H. Parvifolia,* and (2) seeds of *Mammea americana.* These plants, which have shown insecticidal properties, are being investigated to determine their specific values and stability of the active principles, with a view to assessing their economic value for organised production in Colonial territories.

ESSENTIAL OILS

11. *Lippia carviodora from the Somaliland Protectorate.* The dried leaves of this plant, on distillation in steam at the Bureau, furnished 3.15 per cent. of volatile oil, as compared with yields of approximately 1 per cent. obtained by a settler in Kenya in 1944 and 1945 from the same plant, then undescribed, the oils from which were examined at the Imperial Institute. The Somaliland oil was found to be of similar composition to the Kenya oil. It contained 67.3 per cent. of ketones (mainly d-carvone), 29.1 per cent. of terpenes (including about 22 per cent. of d-limonene and dipentene), 2.9 per cent. of free alcohols (probably mainly linalool), and 0.7 per cent. of esters. The d-carvone isolated from this sample compared favourably with that obtained from caraway seed oil; the oil thus provides an excellent source of this ketone. It should also find a market in the United Kingdom for flavouring and perfumery purposes as a substitute for caraway seed oil.

12. *Cinnamon bark oil from the Seychelles.* For some years past attempts have been made to produce in the Seychelles oil of cinnamon bark conforming to the requirements of the British Pharmacopoeia, but from the examination of numerous samples by the Bureau, it became apparent that this was not possible owing to the presence of considerably less phenol in the Seychelles product than that found in Ceylon cinnamon bark oil. For this reason Seychelles oils containing 65 per cent. of aldehydes (the maximum permitted by the British Pharmacopoeia) are not soluble in 70 per cent. alcohol; samples containing about 70 per cent. cinnamic aldehyde possess satisfactory solubility. It was, therefore, decided to attempt to produce an oil of standard quality but containing more cinnamic aldehyde (up to 75 per cent.) than is allowed by the B.P. Two samples distilled in the Seychelles with this end in view were examined. They contained 67.0 and 66.9 per cent. respectively of cinnamic aldehyde and were soluble in 5 volumes of 70 per cent. alcohol, as compared with the B.P. requirement of 3 volumes. Recommendations have been made by the Bureau for further modifications in the distillation technique, with a view to obtaining cinnamon bark oil from the Seychelles of satisfactory quality.

13. *Distilled lime oil from Zanzibar.* In view of damage to clove trees in Zanzibar caused by sudden death disease, and the uncertain future prospects of the clove industry, the establishment of other crops in the Colony is under active consideration. One suggestion is to increase the lime trees already growing in Zanzibar and establish a lime industry, a secondary industry being the production of distilled lime oil from some of the fruit produced. To ascertain whether the type of lime is suitable for the production of an oil of good quality, a sample was distilled at the local Government Laboratory and submitted to the Bureau. It was found that, with the exception of the non-volatile matter, which was high for a distilled oil, the analytical constants were in fair agreement for those of normal samples of distilled lime oil. The high proportion of non-volatile matter may have been due to the preparation of the oil. Apart from this, it would appear that basically the oil was of good quality and, if prepared by carefully controlled methods of modern commercial practice, an oil of considerably better quality would be obtained.

14. *Slash pine from British Honduras.* In connection with the possible exploitation of British Honduras Slash pine (*Pinus caribaea,* Morelet, or *P. hondurensis,* Loock) as a source of " naval stores," a sample of the oleo-resin obtained by tapping this pine was examined by the Bureau. On distillation with steam, the oleo-resin furnished 17.9 per cent. of turpentine oil, the bulk of which conformed to the requirements of British Standard No. 244-1936 for Turpentine, Type 1. The yield obtained was a little low, probably owing to the loss of some of the volatile constituents during transit of the sample or during the tapping operations, and it was considered that with careful handling prior to distillation, yields of 20 per cent. would be possible, which is a good average yield for this type of oleo-resin. On a commercial scale, there should be no difficulty in obtaining satisfactory yields of turpentine oil comparable in every way with the American product.

15. *Sage from Cyprus.* At present the period of the year fixed by law for gathering sage leaves in Cyprus is 1st August to 30th November, but as local opinion concerning the best period for gathering is divided, some considering May to August best, it has been thought desirable to ascertain the best time by actual trial. For this purpose thirteen different localities have been selected, and five samples of leaves from each locality, collected in April, June, July, August and September, 1951, have been received by the Bureau. Results so far obtained by steam distillation of the leaves show that the yield of oil varies considerably from locality to locality, and with the time of year. The character of the oil also varies, some showing evidence of a much greater content of camphor than others. It is hoped that as a result of this comprehensive survey of sage in Cyprus, definite information will be obtained concerning the best time for collecting the leaves and the localities most suited for this crop.

GUMS AND RESINS

16. *Gum Arabic from Tanganyika.* Eighteen samples of gum arabic, collected at the beginning of the gum season, were received for examination. Twelve of these samples came from gum markets in the Shinyanga and Nzega Districts, the remaining six being botanically identified samples. The market samples, apart from one which consisted of gum rejected during grading, were found on examination to resemble closely market samples examined in October, 1948, and were satisfactory with regard to ash, acid value and pH, although all samples furnished solutions characterized by a rather low viscosity. Of the botanically identified samples, two samples of *Acacia senegal* gum compared favourably with cleaned Kordofan gum arabic, except that the matter insoluble in cold water was rather high. Similarly, a sample of gum derived from *A. fischeri* also compared favourably with the Kordofan product except with regard to matter insoluble in cold water, which was rather high, and the dark colour of its solutions. The remaining samples of known botanical identity, *A. spirocarpa* (two samples) and *A. drepanolobium* were similar to the market samples.

17. *Gum Arabic from the Somaliland Protectorate.* In all, thirty-two samples of gum arabic were received at the Bureau, all of which had been collected from individual, marked trees, known to the Somalis as " gum adad." The samples were accompanied by authentic herbarium specimens. The herbarium specimens were identified by the Royal Botanic Gardens, Kew, as " an indigenous Somaliland variant of *Acacia senegal* (L.) Willd." The constants for moisture, ash and pH were normal, but solutions of all the samples examined at the Bureau were characterized by an extremely high viscosity due, it is believed, to the presence of considerable amounts of " insoluble gum." The investigations which have been carried out at the Bureau, whilst based on the examination of very small samples, show that there is strong evidence that " insoluble gum " is always present in Somaliland gum arabic, although derived from *A. senegal,* and solutions prepared from this gum are characterized by a very high dynamic viscosity, which would probably render them rather unsuitable for confectionery manufacture.

18. *Damar and Copal from North Borneo.* Seven samples of damar (Black Damar, Damar Batu, Damar Timbau and Damar Kawang) and one sample of copal dust, on physical and chemical examination, were found, in the case of the samples of damar, to have unduly high contents of dirt and extraneous material,

though the sample of copal dust was satisfactory in this respect. With the possible exception of the sample of Damar Batu, none of the samples was considered by the Technical Committee of the Federation of British Printing Ink Manufacturers to be suitable for use in the manufacture of printing inks, for which purpose they had been submitted. Varnish gum manufacturers and merchants considered that the damars might find an outlet in the manufacture of ships' compositions, and a ready market could be found in the United Kingdom for material of the quality of the sample of copal dust, for use in spirit and paper varnishes.

19. *Slash Pine from British Honduras.* The rosin obtained at the Bureau after separation, by steam distillation, of the turpentine oil, and purification by solution in ether, corresponded in colour with that of American rosin Type "M" according to the standards issued by the United States Department of Agriculture. The analytical constants were similar to those of commercial American rosin, and on a commercial scale a high-grade product could, no doubt, be prepared.

HIDES AND SKINS

20. These products from Colonial territories represent an important source of income for individual producers. The bulk of the material is prepared in a sun-dried condition for the market, without the use of salt, which in Africa, for instance, is too expensive to permit of salt-curing as a general rule. In the straight-drying of hides and skins, earlier research had shown the reasons for the serious faults arising in the old native method of ground-drying, in which the hide was pegged out on the ground, and led to the establishment of suspension-drying as the correct procedure. This may be applied in varying forms provided the principle of free circulation of air on both sides of the hide is observed. The provision of frames or structures for the purpose is not always practicable, as in many areas there is a shortage or absence of suitable constructional material. The adoption of the suspension method to varying local conditions has been a subject of research.

21. *Cattle hides* have recently been examined which were prepared by the "Umbrella" method in East Africa. These were dried off the ground at a distance of some nine inches, between pegs, and over crossed ropes from a centre peg which enabled the middle of the hide to be slightly elevated. The investigation entailed tannery trials in which the hides were examined at various stages in their progress through the tanning operations. The results showed that hides prepared by this method were free from the putrefactive damage and degradation of hide substance, which is liable to occur in ground-dried hides.

22. The cracking on the grain which may occur on dried cattle hides from West and East Africa greatly lowers their value, especially in the case of light hides which are to be finished as upper leather. The damage may be so severe as to make the hide useless for that purpose. A scheme of trials to determine whether excessive stretching during the drying was a cause of cracking was drawn up by the Bureau, and carried out by the Veterinary Department in Nigeria. The hides from the trials were examined by the Bureau in conjunction with a tannery in the United Kingdom. The varying conditions of the trials embraced high tension in a frame, and over poles, in the open. In neither case did excessive stretching during drying cause cracking in the finished leather. In a further set of experiments, the effects of drying in a crumpled state, and of severe folding, were investigated. The results clearly showed that drying on the ground in crumpled condition produced grain-cracking on the hides, and that redoubled folding of dried hides caused more severe cracking, which was very pronounced. The crumpled drying, though not producing the extensive cracking which the redoubling caused, nevertheless gave rise to an undesirable amount of damage. The conclusion to be drawn is that the fault of grain-cracks is associated with low moisture content and strain. It is evident that the grain surface is ruptured when it undergoes a strain in a dry condition.

23. *Goat Skins.* The application of suspension-drying to goat skins has effected a great improvement in their preparation and enhanced their market value. It has

hitherto been thought necessary to dry the skins in the shade as the full force of the sun was suspected as being harmful. The provision of sheds for the purpose is expensive, and trials have been carried out to determine the effect of drying in the open. Further, a simpler method than frame-drying, i.e., by hanging over a line, has been investigated. Trials in conjunction with the Veterinary Departments in Nigeria and Sudan have recently shown that the skins may be dried over lines or in frames in the full sun, yielding a product equal in properties to shade-dried skins. The possibility of a temperature-limit in extreme sun-heat remains to be examined. In line-drying, skins from certain origins in West Africa have shown that in this method of preparation precautions against crumpling of edges and vertical folding whilst the skin is hanging up to dry must be strictly observed, otherwise serious putrefactive damage arises in the folds owing to restricted drying. A method for extending the skin in a suitable simple manner has been devised. Trials in East Africa were initiated by the Bureau for the purpose of ascertaining whether skins prepared by the new line-method could be pressure-baled without suffering damage. A consignment of 2,000 skins was examined, and it was clearly demonstrated that no cracking or other damage occurred as a result of baling the skins in the hydraulic presses employed in East Africa, under the climatic conditions of Mombasa. The possibility of harm arising through pressure-baling in a severely desiccating atmosphere is, however, not ruled out.

PAPER-MAKING MATERIALS

24. In order to overcome the difficulty of obtaining wood-pulp from hard currency countries, renewed attention is being directed to the possibilities of utilising Colonial timbers and agricultural wastes. In past years, a considerable number of such materials have been investigated at the Bureau, and the principal one to find industrial application has been *Eucalyptus saligna.*

25. *Brachystegia wood from Tanganyika* examined during the year was shown to possess a fairly satisfactory cellulose content; 51.4 to 58.8 per cent. on moisture-free material, but the average length of the ultimate fibres, 1.0 to 1.2mm., places it in the category of short-fibred materials for paper-making. To obtain a well-digested pulp by the soda process the conditions required were somewhat severe, and the consumption of soda was rather high. All the pulps were weak in character, and yields were only moderate, 45 to 50 per cent. of unbleached pulp. Under standardised conditions of single-stage hypochlorite bleaching, the pulps required very severe treatment. The loss on bleaching was satisfactorily low, and the pulps suffered little deterioration. On the whole, the papers furnished were soft, bulky, and rather attractive in appearance. Both unbleached and bleached showed a very poor response to beating. The very low a-cellulose and very high b-cellulose figures obtained indicate that the timber would be unsuitable as a source of pulp for the manufacture of artificial silk.

26. A critical examination was carried out on the petioles of the *Nipa Palm,* with a view to utilising the large quantities available in Sarawak. It showed that the material exhibited undesirable features when pulped by either the soda or sulphite processes, the chief of these being the heavy consumption of chemicals, together with low yield, dark colour and high drainage time of the pulps produced. Microscopical examination of the fractionated pulp showed that the wetness was due mainly to the presence of relatively large amounts of non-fibrous tissue, which would present serious difficulties in a paper mill. It is unlikely that the petioles would be an economic source of paper pulp, owing to the high costs of working, and the necessity for removing the parenchymatous tissue.

27. *Sorghum stalks* gave a satisfactory yield of easily-bleached, moderately strong, short-fibred pulp. Fairly severe conditions of cook were required, and the chemical consumption was rather high. The strength of the pulps was not increased to a very high level by beating. The pulps would be suitable for incorporation with longer-fibred material in the manufacture of paper, and could be used alone or in admixture in the production of certain types of fibre board. The content of a-cellulose was found to be 73.5 per cent. on bone-dry pulp, which

renders the pulp of little interest for rayon manufacture. The stalks had a high pentosan content (27.8 per cent. on moisture-free material), and further consideration is being given to the possibility of using them for the commercial production of furfural.

VEGETABLE FIBRES

28. Work has proceeded on two main lines: the examination of jute, jute substitutes and other commercially important fibres, and methods of fibre identification.

29. During the year a number of fibres grown experimentally in the Colonies as part of a scheme to develop production of *Jute-like materials* in these areas were investigated. Jute (*Corchorus* spp.) is not an easy crop to grow and in certain areas, efforts were concentrated on the cultivation of jute substitutes such as *Hibiscus cannabinus, H. sabdariffa and Urena lobata,* some of which were indigenous to the areas concerned. The principal fibres of the jute type examined were: Jute, *Corchorus capsularis* and *C. olitorius* (Gold Coast, Kenya, North Borneo), Kenaf, *Hibiscus cannabinus* (Tanganyika, Cyprus, Northern Rhodesia), *H. sabdariffa* (North Borneo, Zanzibar), *Urena lobata* (Zanzibar, Kenya), *Abroma augusta* (Gold Coast), *Aechmea magdalena* (British Honduras), *Pavonia urens* (Uganda).

30. In addition to the general assessment of length, colour and state of preparation, and microscopical examination of the ultimate fibres, physical tests of fibre fineness and tensile strength were carried out in conjunction with the British Jute Trade Research Association, and spinners' assessments were made by Dundee jute experts.

31. *Jute.* Most of the jutes examined were promising, and the main criticisms concerned the state of preparation and the strength. It was considered that proper attention to the control of the retting process, and the bundling of the fibre, would in most cases produce jute of commercial value. The substitutes examined were all found to be somewhat lacking in strength, and characterized by an inherent coarseness that would not permit them to be spun down to the fine counts necessary to achieve satisfactory production-efficiency on modern jute machinery. Given good preparation, most of the substitute fibres would nevertheless be suitable for conversion to the coarser types of sacking.

32. In connection with the growing of jute or jute substitutes in Colonial territories, and the development of those industries on a major scale, the mechanised harvesting trials of Hibiscus, with the associated features of baling, storing and retting, were continued in Nigeria. A member of the Bureau staff took part in the operations, which have yielded highly satisfactory results.

33. In addition to jute and jute-like materials, several types of fibre of interest to the cordage and allied trades were examined. Fibres from *Sansevieria* spp. grown in the Gold Coast were found not to be suitable for rope-making, except perhaps as temporary materials during the present world scarcity. *Manila hemp* from Malaya was found to be of good quality, and received a favourable commercial valuation. Previous work has also shown that this valuable material can be grown in Malaya.

34. *Fibre Identification.* This subject represents an important aspect of the Bureau's work since fibre samples of unknown or dubious origin are submitted. The customary schemes of preliminary identification based upon burning, staining and other chemical tests are of very limited applicability, as all the stem and leaf fibres react very similarly. Microscopical examination is of much greater value, and a start has been made in building up a reference collection of photomicrographs of fibres obtained from botanically authenticated plants. In addition to the longitudinal and transverse morphological features of fibres, other characteristics have been found to offer a means of differentiation in certain instances. Crystals of calcium oxalate occurring in the cortex take different forms: rhomboidal crystals seem typical of *Corchorus* spp. (Tiliaceae family), and cluster crystals of *Hibiscus*

and *Urena* spp. (Malvaceae family). Measurement of ultimate fibres has also been used as an aid to identification. A given fibre exhibits considerable constancy in the dimensions of its ultimates though, as with all biological material, there is variation about the average values. Statistical methods are indispensable for the effective handling of such measurement data, and extensive use of modern techniques has been made. For example, the two species of jute (*C. capsularis* and *C. olitorius*) are normally distinguished by botanical characters such as form of seed-capsule, but the prepared fibres are superficially identical. By combining three types of ultimate dimension—length, diameter and cell-wall thickness—into a so-called discriminant function, the two kinds of fibre may be assigned to the appropriate species of plant. The success of the method depends upon the available quantity of data, the building up of which is a slow but cumulative process, and at present the risk of misclassification is about 1 in 5. Examination of further specimens and improved techniques of measurement are expected to improve this figure.

TANNING MATERIALS

35. With the increasing demand for boots and shoes generally, including that in countries where footwear has previously been on a primitive level, tanners are giving consideration to future supplies of tanning materials. While wattle bark extract remains the most satisfactory agent for the bulk of the requirements, other materials of different character and as supplementary sources of supply are desired. Attention has been given by the Bureau to a survey of barks and other materials which occur in Colonial territories, and represent possible sources of tannin. The barks of *Eucalyptus robusta* and *E. saligna* from Uganda have been under investigation. The former was found to contain only 1.4 per cent. of tannin, while the latter contained 8.4 per cent. Both samples were too low in extractive matter and tannin, and their infusions too highly coloured to be of interest for commercial purposes. Work is being continued on other materials.

36. The pods of *Acacia arabica,* containing up to 32 per cent. of tannin, are under examination. The tannin is situated in the pod-case, while the seeds, which are devoid of tannin, are liable to cause undesirable fermentation of the tanning liquor, consequently it is sought to market the crushed pods freed from seed in powder form. This product contains over 50 per cent. of tannin, and is a highly satisfactory material in many ways for light leather manufacture, but the amount of iron present in the powder is high and liable to cause staining. The iron may be derived from three sources, sand on the pods, grinding machinery or the material itself. The employment of suitable agents for rendering the iron inactive, during the extraction of the powder, is being investigated.

37. Mangrove bark derived from *Rhizophora racemosa,* in swamp clearing in Gambia for rice cultivation, was investigated in connection with its possible utilization. The tannin content was found to be too low for the bark to be of value for export, while the production of an extract locally is not economically possible.

TOBACCO

38. A number of samples of flue-cured leaf from Kasungu, a new area for tobacco in *Nyasaland,* were examined. The quality was fully up to Rhodesian standard, and the leaf should find a ready market for cigarette manufacture. Mukalla tobacco from the *Aden Protectorate* was under investigation with a view to its improvement and extended utilization. It is grown under irrigation and manured with seaweed. The product is sold in Red Sea markets as a "hubble-bubble" tobacco. It has an ash of unsatisfactory composition, low carbonate with high chloride and sulphate content, and possess a poor flavour and very inferior burning capacity. Further work is necessary to determine whether the faults arising from the local conditions of growing can be overcome, but it would appear unlikely that the area would be able to develop as a source of Virginia leaf. Tobacco grown in the Orange Walk district of *British Honduras* was examined with a view to determining whether a leaf suitable for the export market could be produced. So far the results indicate that with improved cultural treament the smoking quality,

which was somewhat faulty, might be improved to yield a tobacco of the cigar leaf type, while harvesting, curing and varietal trials under expert supervision are desirable to ascertain the possibilities of growing leaf of cigarette type, which is the major requirement today. Eight samples of *Nicotiana rustica* leaf grown in *Cyprus*, from seed obtained from Australia and India, and of interest for the manufacture of nicotine, were found on analysis to have low nicotine contents, 1.1 to 3.5 per cent., as compared with approximately 6 to 8 per cent. in this leaf from other sources. Low nicotine figures are associated with Cyprus tobaccos generally, and rustica leaf of the composition mentioned would not be suitable as a source of commercial nicotine.

OILSEEDS

39. The question of producing *Groundnuts* with properties and composition most suited for the manufacture of protein fibre is being studied in conjunction with the industry concerned, and a member of the Bureau's staff visited West Africa for the purpose of surveying the varieties which are available, the methods of preparation, and the lines on which the desired standard of production might be effected. Numerous samples of local produce were selected for analysis and evaluation at the Bureau. The investigation has developed into a wider survey of groundnut production in West Africa with a view to raising the standard of the industry. The factors under examination are type of nut, composition, decortication and marketing.

40. Other oilseeds under examination included *Wild Sesame*, seed (*Sesamum angolense*) from Northern Rhodesia. The oil obtained from the wild seed was found to contain approximately 9 per cent. of sesamin, and compared with 10 per cent. usually present in commercial oil. Sesamin has proved of synergistic value in the employment of pyrethrum as an insecticide.

WAXES

41. *Trigona wax* produced by the stingless bee of the *Trigona* spp., is sometimes employed to adulterate beeswax. A number of samples of these waxes from Tanganyika have been examined and their constants correlated with a view to establishing a method for determining the amount of trigona wax present in a sample of beeswax. *Sugar cane wax* has been under investigation, together with its market possibilities. The work is being continued.

FOODS AND FEEDINGSTUFFS

42. Various local types of *Barley* from *Cyprus* were examined and submitted to malting trials in conjunction with a firm of maltsters. The purpose was to determine their relative values for export; only one variety, Baladi, however, yielded a useful malt for brewing purposes.

43 Selected samples of *Sierra Leone ginger* were examined with a view to developing superior strains for the export market. The samples under review represented some improvement in quality and complied with the requirements of the British Pharmacopoeia. Fish meal from Sierra Leone, on examination, proved to have a high salt content, though otherwise of good composition, containing 53 per cent. of digestible protein, with 12 per cent. of salt. A sample from Uganda contained 51 per cent. of protein and 15 per cent. of salt. This product would be very suitable as an animal feedingstuff in the United Kingdom if the amount of saline constituent was reduced to 5 per cent. or less.

44. The increasing demand for *Furfural* in chemical industries has directed attention to wastes arising in various producing industries in Colonial territories. The following by-products have been examined in this connection. The potential yields of furfural are shown. Cocoa husks, 8.6 per cent.; Palm kernel shells, 15 per cent.; Palmfruit pericarp residue, 11 per cent.; Palm bunch waste, 12.6 per cent.; Cohune nut shells, 17.3 per cent. On a manfacturing scale the yield of furfural would be of the order of 50 to 65 per cent. of these laboratory figures. All the materials are of promise, but their utilization would depend upon the economics of collection and marketing.

Colonial Products Research Council Ninth Annual Report (1951-1952)

Ministry of Labour,
80–82 Pall Mall,
London, S.W.1.
15th May, 1952.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Products Research Council for the year 1951–52.

I am, Sir,
Your obedient Servant,
(Sgd.) HANKEY.
(Chairman)

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

COLONIAL PRODUCTS RESEARCH COUNCIL

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DR. E. E. CHEESMAN, Agricultural Research Council, London.

MR. C. G. EASTWOOD, C.M.G., Colonial Office.

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

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

PROFESSOR SIR JOHN L. SIMONSEN, D.Sc., F.R.I.C., F.R.S., 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, Medical Research Council, London.

MR. K. G. ASHTON, (*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 its research policy, it will also call into consultation persons with expert knowledge in science, industry, and other related fields."

COLONIAL PRODUCTS RESEARCH COUNCIL

NINTH ANNUAL REPORT

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COLONIAL PRODUCTS RESEARCH COUNCIL

NINTH ANNUAL REPORT

PART I. GENERAL

1. The Council has heard with regret that Mr. Aneurin Davies has intimated to the Secretary of State his desire to retire from the Council. His retirement took place in January, 1952. Lt. Col. H. J. Holman resigned as Secretary of the Council on his departure to take up an appointment in Nairobi under the Desert Locust Control Organisation. His departure is a great loss to the Council, to whom he has rendered most valuable and devoted service. Mr. K. G. Ashton has been appointed as Secretary to the Council.

2. Dr. A. C. Thaysen visited this country for a short time in June and advantage was taken of this to discuss many problems relating to the Institute. It is unfortunate that the pilot plant is still not in operation, and a considerable delay has occurred also in the completion of various repairs. It is hoped that it may soon be possible to appoint a successor to Mr. J. E. Rombouts, who left Trinidad in November on the completion of his three year's appointment. During this period his work on the problem of cocoa fermentation was most valuable.

3. The decision of the Council to establish the Colonial Microbiological Research Institute has been fully justified by the valuable work which it has carried out under the direction of Dr. A. C. Thaysen. It is being increasingly consulted by various industries in the West Indies and a much wider use of its facilities is likely to result from the appointment during the last year of correspondents in other Colonies.

4. At the Cocoa Conference held in London last September Dr. Forsyth gave an account of the important work carried out in this laboratory on the fermentation of the cocoa bean. This work received general commendation and there is no doubt that a real advance has been made in the study of this difficult problem. The results so far obtained are likely to prove of immediate value to plant breeders since it enables commercial evaluation to be made of small samples of beans, but much further work will obviously be required before the results can be applied in the industry. There would appear to be little doubt that, contrary to the usual view, the main fermentation is anaerobic.

5. A provisional patent has been taken out to cover the preparation of the antibiotic, comirin. Much work is still required to determine the most efficient method for its preparation and little is yet known of its chemical structure. Clinical trials have been initiated both in Trinidad and Jamaica. The former are being carried out in collaboration with the Director of Medical Services, and the latter with the Dean of the Medical Faculty of the University College of the West Indies. The results, which show distinct promise, are referred to in greater detail in paras. 75–79. A number of laboratories both in this country and abroad have been supplied with specimens of the antibiotic.

6. In collaboration with a firm in this country an investigation is being undertaken on the possibility of growing in the tropics a yeast having a high ergosterstol content. If this should prove successful it should be possible to produce the yeast at the Food Yeast Factory in Jamaica.

7. The Hankey Culture Collection, of which Miss Morris is the Curator, now contains over 500 specimens of which 84 were isolated from Trinidad sources during the year. Its value is shown by the fact that 60 cultures were sent to scientific institutions and commercial firms during the year.

8. Professor C. H. Hassall and Miss L. Wong in the University College of the West Indies in Jamaica have made some progress in the purification of the antibiotic, which is formed from the culture of Meredith's actinomycete obtained from the Hankey Culture Collection, although the work has naturally suffered some delay owing to the disastrous hurricane which struck Jamaica. Miss Wong's appointment has now ended, but it is hoped later in the year to obtain another assistant.

9. With the completion of the Sugar Technological Laboratory in Trinidad, to which reference was made in last year's report (para. 4), it has proved possible for Professor L. F. Wiggins to proceed to examine the possible economic uses of some of the products derived from sugar which had previously only been examined on a laboratory scale. The possibility of extracting and purifying the wax present in the filter mud resulting from the extraction and clarification of the juice has been further investigated. Preliminary experiments had already shown that the best solvent for the extraction of the wax was benzene, but since this solvent was not available locally various hydrocarbon solvents supplied by Messrs. Trinidad Leaseholds Ltd. were examined and two of these proved satisfactory. The crude wax contains varying quantities, dependent upon the source, of fatty materials which it is essential to remove. It has been found that this can be effected by treatment with fusel oil obtained from local distilleries. A wax having a light yellow or grey colour and melting at 78–80° can readily be prepared. Preliminary experiments suggest that it is suitable for various industrial purposes and it is clear that the stage has now been reached when a survey should be made to determine whether there is a remunerative market for it. This is now in progress.

10. Improved methods for the preparation of levulinic and lactic acids from sucrose were worked out in the Birmingham University Laboratories by the late Sir Norman Haworth and Professor Wiggins. The possibility of utilising these for their manufacture is now being studied in Trinidad. The preparation of levulinic acid from molasses has been examined, but certain difficulties have been encountered and the yield so far has been unsatisfactory. It is hoped to overcome these difficulties by further work.

11. Although most of the lactic acid now manufactured is made by fermentation processes a chemical method would have many advantages in tropical countries. Since for many industries the esters of lactic acid are required, the possibility of preparing these without isolation of the acid has been examined. These experiments are very promising and are now being further studied.

12. Reference was made in last year's report (para. 56) to the initiation of work on the constituents of cane juice obtained from various sections of the cane. These are still in progress and may give results of considerable importance.

13. In view of the availability of considerable quantities of bagasse which are not required for the production of power in the sugar mills, a detailed knowledge of its constituents is desirable if other uses are to be found for it. It is already known that the principal constituents are cellulose, pentosans and lignin. The possibility of separating these has been studied and a successful process, using an alkaline solution, has been found for isolating the cellulose in a form suitable for the manufacture of paper. In view of the world shortage of pulp the Council considers this work important.

14. In a report to the Council Professor L. F. Wiggins refers to a number of *ad hoc* investigations which indicate that his laboratory is already proving of considerable value to the sugar industry.

15. After a very long delay it is gratifying to be able to report that the equipment for the special laboratory at the Forest Products Research Laboratory, Princes Risborough, has at last been supplied. It is therefore with profound regret that we have to record the sudden death of Mr. W. G. Campbell, who was responsible for the design of the apparatus and under whose direction the research on the utilisation of Colonial secondary timbers was being carried out. He had a unique knowledge of the manufacture of fibre hardboard, which was refreshed by repeated visits to the United States. The work is now under the direction of Dr. R. H. Farmer, with whom Mr. D. F. Packman is associated.

16. The preliminary experiments in this field have been carried out with Wallaba wood. This wood has a high resin content and is therefore not a representative timber. It has, however, proved possible to make from it a series of hardboards having good properties. Some hardboards have been made also from this wood after the extraction of the resin. These experiments will be continued using *Mora* wood and also two Malayan timbers.

17. In the University of Nottingham under the direction of Professor F. E. King the constituents of various Colonial hard woods are being examined. This work, which is being carried out in close collaboration with the Princes Risborough Laboratory may throw some light on the problem of the resistance of timbers to insect and fungal attack.

18. Investigations in the field of carbohydrate chemistry have been vigorously continued in the University of Birmingham under the direction of Professor M. Stacey, F.R.S., who has been assisted by two members of his staff, Dr. E. J. Bourne and Dr. J. C. Tatlow. These are discussed in detail in para. 34.

19. Although the value of dextran as a blood plasma substitute is now well established, it still provides many problems requiring further investigation. Utilising improved analytical methods recent work has shown that the current views on its structure are incorrect. It has been found also that dextran is a mixture of materials having a wide range of molecular weights. A closely related polysaccharide prepared by Dr. E. J. Hehre of New York has been examined and it has been found to be of the dextran type.

20. Investigations on the most suitable method for the production of bacterial cellulose from sucrose and other carbon sources have now reached the stage when it seems desirable that trials should be conducted in a pilot plant in order to determine whether cellulose prepared by this method can be produced at a cost enabling it to meet some of the normal industrial requirements.

21. During the past few years a number of sugar derivatives have been prepared which show properties which can be described as anti-allergic. Mr. G. C. Haining working under the supervision of Professor A. C. Frazer of the Department of Pharmacology, University of Birmingham, has been engaged in developing more satisfactory methods, depending upon the release of histamine, for determining this property. He has been able to screen, in a preliminary manner, a large number of substances. Much further work will be necessary before the accuracy of this new technique can be assessed.

22. The work in Professor S. Peat's laboratory during the past year has been concerned mainly with the confirmation of previous results obtained with starch metabolising enzymes. Improved methods have been devised for the isolation and purification of these enzymes and with these purer specimens a clearer definition of their functions is now possible. Whilst this work is at present only of scientific interest and importance a full knowledge of all aspects of starch chemistry is essential if a technical use is ultimately to be made of the potentially rich sources of starch available in the Colonies.

23. About eighteen tons of the heat-dried oil seeds of *Tetracarpidium conophorum* have been received from Nigeria and an excellent oil has been extracted from these under the supervision of Dr. L. A. Jordan, Director of the Paint Research Laboratory. The Council is greatly indebted to Dr. Jordan for the valuable assistance which he has given. This oil is now being distributed by him to various firms in the paint industry for technical evaluation. About one ton of the oil cake, containing approximately six per cent oil, has been sent to Professor H. D. Kay, F.R.S., Director of the National Institute for Research in Dairying, for feeding trials. It is already known that the cake is a satisfactory stock feed but it is considered desirable for further experiments to be carried out.

24. Work under Dr. M. L. Meara's direction in the University of Liverpool has been concerned mainly with two problems; the nature of locust fat, and the constituents of coconut oil. The first of these investigations was undertaken at the request of Dr. B. P. Uvarov, F.R.S., Director of the Anti-Locust Research Centre. The Council has welcomed this opportunity of assisting the important work being carried out by this Centre on the control of locusts.

25. Experiments have been carried out in the East African Industrial Research Board's Laboratory on the extraction of oil from *Moringa oleifera* and *Aleurites triloba*. The oil from the former has been found to be peculiarly effective as a flotation agent. The latter oil has possibilities in paint manufacture.

26. The Council's advice was asked by the Director of Agriculture, Nyasaland, and also by the Colonial Development Corporation, on the most suitable method for the evaluation of Tung oil, the production of which is being extended in this Colony. Professor T. P. Hilditch and Dr. L. A. Jordan have been able to give valuable advice on this and have suggested the use of a spectrographic method in place of the usual empirical gel test.

27. The increased interest which is being shown both in the United States and in Canada in the manufacture of vanillin from lignin, which provides a cheap source of this substance, enhances the importance of finding new uses for eugenol, the chief constituent of clove oil. In this country eugenol finds its main use as a source of vanillin. Unfortunately, in spite of the long series of experiments which have been carried out in Professor G. R. Clemo's laboratory, the Council is unable to report any significant advance.

28. In spite of the very great experimental difficulties due to the small quantity of material which can be isolated, progress has been made in the study of the germination factor of Striga referred to in para. 39 of last year's report. This work is being carried out in the Chemistry Department of the University of Cambridge by Dr. A. W. Johnson and by Dr. R. Brown of the Department of Botany, University of Leeds. The crystalline factor has not yet been obtained, but preliminary chemical work has been carried out on the resinous concentrates. It is too early to speculate on the chemical nature of the compound. Segments of the host root have been shown to convert glucose to the active principle and it is possible that 2-ketogluconic acid, which has been isolated from the reaction product, is an intermediate.

29. The investigations on the constituents of various plants referred to in last year's report (para. 38) have been continued and work on a number of new plants has been commenced. This increased interest in Colonial plants is to be welcomed since it is probable that results of both scientific and technical value will follow. The Council desires to place on record its appreciation of the valuable assistance it has received from Colonial Agricultural and Forestry Officers who have undertaken the laborious task of collecting material.

30. Last year further trials were carried out in Nigeria on the mechanical harvesting of *Hibiscus cannabinus*. A new machine was designed by Mr. Bradley of the National Institute of Agricultural Engineering and this was found to be highly satisfactory. In view of the successful outcome of these experiments it has been decided to proceed with further trials with jute in British Guiana. It seems probable that jute can be successfully grown in this Colony and the results of the new experiments will be awaited with interest. Since this problem is now largely agricultural the Council will no longer be responsible for supervising the work, but doubtless its advice will be sought at a later stage in connection with the retting of the fibre.

31. During the year the Secretary of State sent a despatch to all Colonial Governments asking them if they had any problems in the solution of which the Council could assist. A similar request was sent by the Director of Research to the Council's correspondents in the Colonies, and as a result a number of requests were received. In many cases it was found possible to provide a reply without any research. Promises of collaboration in experimental work have been received from the Brewing Industry Research Foundation, the Flour Millers Research Association and the National Institute for Research in Dairying, Reading. The Council is grateful for these offers.

32. A request was received from the Director of Medical Services, Cyprus which may result in a major investigation. The disease known as Fabism occurs in the Mediterranean Islands and is said to be the result of the consumption of the beans of *Vicia faba*. Samples of beans from Cyprus are now being grown at Kew under the direction of Sir Edward Salisbury, Secretary of the Royal Society, and it is hoped to arrange for beans from these plants to be examined by Professor E. C. Dodds, F.R.S., at the Courtauld Institute of Biochemistry, Middlesex Hospital, and later for their chemistry to be studied by Dr. H. N. Rydon, Imperial College of Science and Technology.

PART II. REVIEW OF RESEARCH WORK IN PROGRESS

33. (46)* Mr. P. Lees, working under ... ...ion of Professor G. R. Clemo has studied in some detail the hydrogenation of eugenol. An improved method for the preparation of 2-methoxy-4-propyl*cyclo*-hexanol has been found, but it has not been possible to oxidise it to the corresponding ketone. This has been prepared by an indirect method and converted into a number of derivatives. Mr. R. W. Temple has continued his study of *iso*quinoline derivatives derived from eugenol. None of those so far tested have been found to exhibit pharmacological activity. Recently bases resembling in structure the alkaloid, papaverine, have been prepared and it is hoped to arrange for their physiological properties to be examined.

Carbohydrates

34. (47) *Sugar*. Earlier investigations in the Birmingham Laboratories had confirmed that the primary alcohol groups in carbohydrates could be oxidised to carboxyl groups by treatment with oxygen in the presence of a platinum black catalyst. Mr. J. G. Fleetwood has attempted to prepare uronic acids containing amino and phosphate groups, by this simple and effective method. Unfortunately the method fails completely with glucosylamine and glucosamine and the facile oxidation of α-and β-methylglucosides was inhibited in the presence of ammonium salts or of glycine. On the other hand the Cori ester gave tripotassium α-D-

* Figures in parentheses refer to the corresponding paragraph in the 1950–1951 Report.

glucuronate-1-phosphate. This salt is therefore available for the first time and experiments have already shown that it will prove of value in enzymic syntheses of polyglucuronides.

35. Mr. G. P. McSweeney, as part of an extended study of acetals and ketals of the polyhydric alcohols has been investigating the *iso*propylidene derivatives of D-sorbitol and L-iditol. This work has resulted in the preparation of substances likely to lead to useful intermediates for the synthesis of hexitol derivatives.

36. Work on the preparation of trifluoroacetyl derivatives of the carbohydrates is being carried out by Mr. A. J. Huggard. Some further derivatives are 4:6-benzylidene trifluoroacetyl-α-methylglucoside have been very thoroughly investigated, and a start has been made with the study of the condensation products of hexitols with trifluoroacetone. Mr. J. Roylance is examining the fluorination of heterocyclic substances derived from cane sugar.

37. (48). *Dextran.* In continuation of previous work on polysaccharides Mr. G. C. T. Bruce has studied the structure of a polysaccharide prepared by Dr. E. J. Hehre of New York, by the treatment of dextrin with an enzyme isolated from *Acetobacter capsulatum.* This has been shown to be a polyglucose and that it is probably, as suggested by Dr. Hehre, a polysaccharide of the dextran type.

38. A parallel investigation has been carried out with the dextran from *Betacoccus arabinosaceous*, the material used as a blood plasma substitute. These experiments have confirmed the previous results that the average chain length is 6-7 glucose units but contrary to the previous view the cross linking is not of the 1: 4 type. This is an interesting development which is being studied in various dextrans.

39. Since the molecular weight of dextran is of great importance, Mr. G. A. Gilbert and Mr. R. T. Bottle have been examining a variety of dextran fractions by ultracentrifugal methods. The material prepared by acid hydrolysis shows the presence of fractions having a wide range of molecular weights.

40. *Bacterial Cellulose.* Studies made under Professor M. Stacey's direction on the production of bacterial cellulose from sugars and a variety of other carbon sources have reached a stage where pilot plant development can be contemplated.

41. (59). *Starch.* Studies of the Q-enzyme from *Polytomella coeca*, which catalyses the conversion of amylose into amylopectin, have been extended by Mr. A. Bebbington. An interesting aspect of the mechanism of the enzyme action is that the rate of the reaction is increased by oligo-acid polysaccharides composed of 1: 4-α-linked glucose units but not by any other saccharides; the efficacy of this priming action seems to be dependent upon the concentration of non-reducing end-groups. It is hoped to prepare a crystalline sample of the enzyme to determine whether the pure enzyme has any action at all on amylose.

42. Mr. T. R. Carrington has examined the action of ultrasonic waves generated in a quartz crystal oscillator on starch, amylose and amylopectin solutions. Certain anomalous results have been traced to the formation of nitrous and nitric acids formed presumably from atmospheric nitrogen during the irradiation process.

43. Improved methods have been developed in Professor Peat's laboratory in the University College of North Wales for the isolation and purification of R-enzyme, Z-enzyme, α- and β-amylases, Q-enzyme and phosphorylase. With the availability of these purer specimens a clearer definition of their functions has been possible. This work has only been possible by the perfection of partition chromatographic methods.

44. The R-enzyme has been found to have one function only, namely the irreversible hydrolytic scission of the branch links in amylopectin. The Z-enzyme is a β glucosidase and with its aid it has been possible to make the important observation that, contrary to the view previously held, amylose does not possess a linear structure but does, in fact, contain branch linkages. It differs therefore fundamentally from cellulose.

45. The Q-enzyme has been recognised as a trans-glucosidase. With phosphorylase it has been found possible to synthesise amylose chains of a pre-determined length and it is now clear that in the plant phosphorylase and the Q-enzyme function independently.

Sugar Technological Laboratory, Trinidad

46. *Sugar.* Although it was known from the earlier experiments of the late Sir Norman Haworth and Professor L. F. Wiggins (British Patent No. 683,533, 1944) that sucrose could be converted into levulinic acid in excellent yields (75-80 per cent) the method had not been applied to molasses. Preliminary experiments have now been carried out with this material in a specially designed autoclave resistant to the attack of hydrochloric acid. At present yields of only 42-47 per cent of the acid have been obtained and Professor Wiggins admits that the project is one of considerable difficulty. Since an industrial offer has been received for the purchase of a large quantity of the acid, it is desirable that further experimental work should be carried out.

47. In investigating the direct formation of ethyl and butyl lactates from molasses without a preliminary isolation of the acid, Messrs D. W. Chadwick and A. P. Thomson heated a mixture of molasses, lime and water in an autoclave at 210–240°. The cooled mixture, after treatment with sulphuric acid to precipitate the calcium sulphate and filtration, was distilled with butyl alcohol, when butyl lactate in a yield of 43 per cent was obtained. This was found to account for practically the whole of the acid present. A somewhat similar experiment using ethyl alcohol in place of butyl alcohol in order to prepare ethyl lactate, was less successful, only about half of the acid present being recovered. It is, however, anticipated that the method adopted is capable of improvement.

48. Since it has been shown by Lockwood and Ward of the U.S. Department of Agriculture that itaconic acid can be obtained in a yield of 20-25 per cent from glucose by the growth of the mould, *Aspergillus Terreus*, attempts have been made to produce this acid from molasses. The Colonial Microbiological Research Institute supplied Messrs. J. Winstanley and D. W. Chadwick with species of *A. Terreus*, but these did not yield any itaconic acid when grown on molasses. This work is now being repeated with a species of the culture used by Lockwood and Ward.

49. Closely related to this investigation were experiments carried out by Mr. J. Drane in the Physical Chemistry Department, to find an accurate method for the determination of the aconitic acid content of molasses. This estimation is of importance since the recovery of the acid from molasses is only economic when not less than 2 per cent of acid is present. An attempt was made to use the polarographic method of analysis, but various difficulties were encountered. The majority of these were successfully overcome and it is anticipated that a satisfactory method will be devised.

50. It has been suggested by Mr. D. N. Ghosh that it is possible to remove the colloids present in sugar cane juice by the electrolysis of the juice in iron cells and to use this method in place of the usual lime-heat treatment. Mr. J. Drane has

carried out a prolonged investigation on this subject and the conclusion has been reached that by electrolysis the pH of cane juice can be raised to an alkaline value without the addition of lime and that electrolysis in an aluminium cell removes most of the colloids originally present in the juice. By using an after treatment with superphosphate of lime at 100° good clarified juice can be obtained, which appears to be superior to that obtained by the conventional lime-heat process. This investigation offers the possibility of a new process for the clarification of cane juice.

51. (56). Mr. J. H. Williams has carried out a detailed study of the various constituents of cane juice which comprise sugars, carboxylic acids, amino acids and pigments. With regard to the sugars, it was known that the juice contained glucose, fructose and sucrose and an analysis by paper partition chromatography did not reveal the presence of any other sugars in the juice from the cane variety B.37.16.

52. Estimations of the sugars were carried out at intervals during the growth of the cane and also in varying parts of the cane stems. It was found that the glucose and fructose concentration rises to a maximum at a point just below the very top of the cane. It is at this point that the colour of the exterior of the cane changes from green to purple and it is likewise at this point that the rapid rise in the sucrose content of the cane commences.

53. The carboxylic acids present in the cane were found to be aconitic, citric, malic, glycollic and possibly glyoxylic; lactic, pyruvic and fumaric acids were absent. It is probable also that glucose-1-phosphate is present in the juice.

54. The cane juice from B.34.101 contains twelve different amino acids and these were present in other cane juices examined although the concentration of the acids varies. The amino-acid concentration is greatest in the top-most portion of the cane, falls to a minimum in the main part of the cane and then rises at the bottom.

55. (53, 54). After a considerable delay the extraction of sugar cane wax from the filterpress mud on a pilot plant scale has commenced, and the wax is now being prepared in quantity. Two satisfactory solvents, GS.937 and 938, were selected from a number of solvents obtained from Trinidad and Curaçao and have been found nearly as satisfactory as benzene. As mentioned in the last report the filterpress mud from the St. Kitts factory provides a crude wax showing only about 20 per cent of fatty material. This has to be removed in the refining process. The removal is best effected by extracting the crude wax in admixture with bentonite and carbon black with fusel oil at about 70°C. The filtered solution on cooling deposits the wax as a light yellow or grey crystalline material, m.p. 78-80°. This process is successful also with crude wax from a Trinidad factory containing about 45 per cent of fatty material. The solvent can be removed from the filtrate, leaving a fatty residue for which so far no use has been found. It contains a small quantity of a mixture of sterols which do not, however, appear to be of economic value.

56. Experimental quantities of polish have been prepared from the wax which appear to have satisfactory properties, but examination of the wax by the industry is still required.

57. *Bagasse.* It is already known that the main constituents of bagasse are cellulose, pentosans and lignin. If bagasse is to be found of industrial use it is essential that a more detailed knowledge of all the constituents should be available, and Mr. J. V tanley has commenced work on this subject. He is examining

also the possibility of obtaining from bagasse material suitable for use in the manufacture of paper. By treatment with sodium hydroxide-"hydros" a "holocellulose" (a mixture of cellulose and pentosans) has been prepared. After further treatment this material was sent to the Paper Division of the Manchester College of Technology and, as will be seen from the table given below, gave promising results. Further work on this important subject is in progress.

Table 1

ANALYSIS OF PAPER MADE FROM BAGASSE HOLOCELLULOSE

Beating in Lampden mill, revs.	0	9,000	20,000	Newsprint
Bulk (weight)	165	132	115	104
Breaking length (metres)	950	1,125	1,280	1,266
Burst Factor	2·0	5·4	5·6	4·4
Tear Factor	33·3	33·7	39·4	35·1
Substance (gms./metre)^2	55·0	68·2	58·4	52·8

(Variation in substance has been allowed for in calculating other results.)

Timber Research

58. (61) *Mimusops heckelii* (West Africa). From this timber Professor F. E. King and Mr. J. A. Baker have separated a saponin which contains sulphur and yields on hydrolysis a crystalline hydroxy-triterpenoid acid, $C_{30}H_{46}O_5$, together with xylose, rhamnose, glucose and a sulphate ion. The acid appears to be saturated and it contains adjacent hydroxy groups, since it yields an *iso*propylidene derivative.

59. *Berlinia species.* From the wood of *Berlinia* species, Mr. Baker has separated pinitol and an uncharacterised fatty acid, $C_{20}H_{40}O_2$.

Oils and Fats

60. *Coconut oil.* The component fatty acids of a specimen of coconut oil examined by Dr. M. L. Meara and Miss A. R. Dale has been found to be caproic 0·2; caprylic 7·7; capric 9·7; lauric 45·0; myristic 18·0; palmitic 8·4; stearic 3·7; oleic 5·8; linoleic 1·5. The range of the even membered saturated acids present in coconut oil and indeed of the fats of the *Palmae*, extending from caproic to stearic acid is far greater than that which obtains in the seed fats of most other botanical families. It follows that coconut oil may be expected to consist of a very complex system of mixed glycerides. It is hoped that the experiments now in progress may throw light on this problem.

61. *Locust fat.* At the request of the Anti-Locust Research Centre an investigation has been commenced on the fat content of locusts caught by the mobile research unit in Africa. As a preliminary to this work it was necessary to devise a satisfactory method for preserving the locusts. Two methods were suggested, (*a*) air drying at 100° and (*b*) preserving in 5 per cent formalin. It appears probable that preservation in formalin may prove to be the more satisfactory, but the detailed analysis so far carried out has revealed certain anomalies which require elucidation. One curious feature is that whereas the free fatty acid content in the body fat of locusts killed and extracted immediately is 17·2 per cent, that found in those preserved in formalin is only 8·2 per cent.

Plants of possible Medicinal and Insecticidal Value

62. (84) *Hydrocotyle asiatica* (*Centella asiatica*) (Ceylon and Uganda). As has already been reported, it was shown by Dr. Bhattacharyya, working under the direction of Dr. Lythgoe, that this plant contains a mixture of triterpenoid acids.

An examination of a further batch of material from Ceylon by Mr. de Mayo, working under the direction of Dr. D. H. R. Barton, has established the fact that these acids occur in the plant as glycosides. Hydrolysis of the glycosides gave centoic acid. Although this acid yields crystalline potassium and brucine salts it is itself amorphous and no other crystalline derivatives can be prepared. The acid, in a smaller amount, is present in the plant from Uganda obtained through Mr. J. W. Purseglove. In view of the work on this subject, which is in progress in France, further investigation has been suspended.

63. (86) *Mitragyna alkaloids* (Nigeria and Tanganyika). Work on these alkaloids under the supervision of Professor J. W. Cook, F.R.S., and Dr. J. D. Loudon continues. A fresh supply of bark of *Mitragyna rubrostipulaceae* has been secured and arrangements for its extraction are in train. Mr. R. M. Gailey has started degradation studies on mitraphylline. The synthesis of 7-methoxy-1:2-dimethyl-β-carboline, mentioned in last year's report, has been published (Cook, Loudon and McCloskey, *J. Chem. Soc.*, 1951, 1203) and Mr. P. McCloskey has now synthesised the degradation product of mitragynine (Ing and Raison, *ibid*, 1939, 986) which is found to be 6-methoxy-1:2-dimethyl-β-carboline. A second synthesis of this last compound has been effected in collaboration with Mr. G. G. Doig who is engaged on further work designed to provide reference compounds of the β-carboline type.

64. (90) *Phyllanthus engleri* (East Africa). From the root bark of this species Dr. F. B. Kipping and Dr. K. B. Alberman separated a triterpenoid alcohol, phyllanthol, which has been further examined by Dr. D. H. R. Barton and Mr. P. de Mayo. As the outcome of an ingenious series of experiments, involving the use of deuterium, it has been shown to be a *cyclo*-derivative of α-amyrin. An attempt is now being made to distinguish between the only two possible representations.

65. *Lippia Rehmanni*, Pears. The fatal disease, icterus, in sheep in Africa, is caused by the grazing of the leaves of *Lippia Rehmanni*, Pears. Professor C. Rimington has placed plant material from this source at Dr. Barton's disposal and, in collaboration with Mr. P. de Mayo, he has separated from this a substance, icterogenin. At least three other substances are present, one of which is oleanolic acid. The chemistry of icterogenin is being investigated.

Colonial Microbiological Research Institute

The Fermentation of the Cocoa Bean

66. (95) *Microbiological study.* During the year the microbiology of fermenting cocoa beans has been further investigated, particularly as it concerns the Trinidad practice of preparing cocoa beans for the market. As previously reported yeasts appear to be the first types of micro-organisms invading the pulp of fresh cocoa beans. Their numbers amount to 90–95 per cent of the total micro-flora after only twelve hours fermentation. Their actual numbers continue to increase during the succeeding twelve hours, when a maximum is reached which remains constant up to nearly sixty hours after the beginning of the fermentation. After only twenty-four hours fermentation, the relative proportion of yeasts to the total micro-flora has dropped to 40–50 per cent and acetic acid bacteria have reached a similar percentage of the total micro-flora. The numbers of acetic acid bacteria continue to increase thereafter until they constitute from 80–90 per cent of the total, after forty-eight hours fermentation. These facts undoubtedly have considerable effect on the processes taking place on and within the fermenting beans resulting in a rise in temperature, in the reduction of available oxygen, and in the lowering of the pH of the beans undergoing fermentation. The significance of this is being

borne in mind in the investigations now proceeding on the elaboration of an aseptic method for the preparation of cocoa beans for the market.

67. The fresh cocoa beans contain other micro-organisms besides yeasts and acetic acid bacteria. One group of these, the aerobic spore forming soil bacilli, may compose as much as 30-40 per cent of the initial micro-flora, but plays little, if any, part in the initial fermentation process, since their numbers drop to less than one per cent of the total at the end of twelve hours fermentation. They become significant only after three days fermentation when their numbers constitute some 80–90 per cent of the total microflora, not because they have by then increased significantly in numbers, but because of the more important groups already mentioned rapidly dying off.

68. Yet another group of micro-organisms, the non-spore forming bacteria of soil and water habitats, begin to appear after seven to eight days fermentation, at a time when the fermentation should normally have been completed. They may be regarded as harmful since they produce undesirable odours, and their presence in appreciable numbers is an indication that the fermentation has been proceeding beyond the desirable limits.

69. These, and many other observations gathered in a study of the micro-organisms of fermenting cocoa beans have been assembled in a report by Mr. J. E. Rombouts which is now in the press.

70. (96) *Cocoa flavours.* The study of the changes suffered by cocoa beans when exposed to temperatures of 45° to 48°C. in the presence of acetic acid and/or acetates, has been further pursued during the year, but no definite conclusions have as yet been reached. Should this study yield positive results, it might lead to the development of typical chocolate flavours in cocoa beans fermented in the absence of micro-organisms.

71. Much attention has been paid during the year to the study of the chemical changes resulting from the fermentation of fresh cocoa beans. Methods for the fractionation of the polyphenolic components of fresh cocoa beans and for studying the changes in these compounds during the fermentation, have now been satisfactorily developed. The investigations carried out using these methods have been submitted for publication.

72. It would appear that the enzymic changes in the cotyledons during the commercial fermentation of cocoa beans, take place in an almost complete absence of oxygen. The most striking chemical change is found in the conversion of compounds containing cyanidin in their basic structure. The leucoanthocyanins appear to play a considerable part in the development of the characteristic chocolate aroma. At present, attempts are being made to isolate the key leucocyanidin compound in large quantity for structural investigation. Work with substrate-free enzyme preparations acting on the various isolated polyphenols under anaerobic conditions is also in progress.

73. An investigation on the form of occurrence of the pigments in fresh cocoa beans has also been presented for publication. A brief note on the form of occurrence of caffeine in the cocoa bean has been published.

74. (100) *The Study and Isolation of Antibiotics.* Most of the available time has been taken up during the year with the production and isolation of the antibiotic, comirin, which was provisionally patented under that name on the 31st May, 1951. Though it may be claimed that both the production and the isolation of comirin is now carried out under standardised conditions, there is little doubt that much work is needed before the most efficient methods have been elaborated.

The chemical structure of comirin may, in part, be responsible for this. Recently it has been observed for instance that the final drying of comirin greatly influenced its antifungal properties.

75. During recent months, clinical trials with comirin have been initiated both in Trinidad and in Jamica. In the former centre, the trials are being carried out in collaboration with the Director of Medical Services; in the latter, in collaboration with the Dean of the Medical Faculty of the University College. The trials have necessitated the initiation of a study of the microbiology of skin infections of man and animals, an investigation which, where necessary, is being undertaken in consultation with the Oswaldo Cruz Institute at Rio de Janeiro; with the Government Pathologist in Port of Spain, and with the Dermatologist attached to the University College of the West Indies. The investigation has already shown that the microbiology of skin infections is more complex than was anticipated, and that the isolation and identification of the fungi and yeasts found, offers considerable difficulties. Nevertheless, the elaboration of a new medium has made the actual isolation of fungi much more certain than it was when the standard medium for the purpose was used exclusively. The actual identification of the fungi and yeasts will, when necessary, be done in consultation with experts in this field.

76. Altogether, the clinical trials have, at the time of writing, proceeded far enough for Dr. M. A. Fawkes, the Medical Officer supervising the Trinidad trials, to issue a provisional report containing the following tentative conclusion:

> " The fungus skin infections commonly known as Tinea corporis, Tinea cruris, and Tinea interdigitale, have been found to respond to topical applications of Comirin."

77. In large measure this is confirmed by a Trinidad Ear Specialist, Dr. E. C. Richardson who, early in the investigation undertook to determine the effect of comirin on cases of " Tropical ear " infections. In ten cases of this complaint, where the infecting organism was *Aspergillis flavus*, or *Candida parapsilosis*, or a mixture of both, complete recovery was secured after three applications of comirin in a water solution of comirin containing one part in 50,000 parts of water. Where the " Tropical ear " was caused by a gram negative, motile or non-motile short rod, comirin was found to be ineffective.

78. Tentative experiments have been carried out on the systemic introduction of comirin into various plants. This work for which Professor R. L. Wain of Wye College, Kent, has in large measure been responsible, has not yet yielded positive results, and the whole question of the use of comirin in the treatment of plant infections is still awaiting investigation.

79. *Distribution of Comirin.* During the year comirin was sent for testing to the following interested organisations and persons :—

Messrs. Glaxo Laboratories, Ltd., London.

Dr. Gerald Spencer, M.D., New York (Skin and Cancer Hospital).

E. I. Du Pont de Nemours Co., Delaware.

The American Consulate, Port of Spain, on behalf of the State Department, Washington.

Professor R. L. Wain, Wye College, Kent.

Dr. Oscar Fredrik Guldberg, Norway.

Dr. G. A. Ledingham, National Research Laboratories, Saskatchewan.

Professor E. K. Cruickshank, Jamaica.

Mr. C. Beauregard, Caribbean Commission on behalf of Mr. Merny, Guadeloupe.

Professor de Fonseca, Oswaldo Cruz Institute, Rio de Janeiro, Brazil.

80. *Sterol work.* In collaboration with workers in this country an investigation has been carried out on the cultivation of a yeast having a high sterol content. The yeast, which grown in London gave a satisfactory yield of ergosterol, is being grown in Trinidad to determine its ergosterol production when grown under tropical conditions. At the same time an examination is being conducted for other strains of yeast which may give high yields of this important sterol.

81. (98) *Hankey Culture Collection.* Requests for cultures from scientific institutions and commercial firms have been received and during the year sixty cultures were sent out: twenty-four bacteria; twenty fungi; twelve yeasts; and four actinomycetes.

82. In collaboration with the Caribbean Medical Centre and with an Ear Specialist in Port of Spain, a study of the pathogenic fungi and yeasts has been undertaken. Skin scrapings taken from suitable patients have been examined and the fungi present identified.

83. The assistance of the Collection was requested by a firm in British Guiana in solving the problem of discolouration of paint-work by fungi. The organism was identified but so far attempts to repeat the damage experimentally have proved unsuccessful.

84. Other work undertaken by the Collection concerned the discolouration of stored bagasse, improvement in the flavour of the local margarine, and the production of citric acid by fungi, work referred to in other sections of this report.

85. The Collection now contains just over 500 species of which eight-four were isolated from Trinidad sources during the year, including forty-eight types of pathogenic fungi and twelve types of yeasts from skin lesions.

86. *Miscellaneous investigations.* During the year 1951/52, the Institute has again been called upon to assist various undertakings in developing and expanding their activities. The previous report recorded that the Citrus Company of Jamaica, Ltd., were interested in securing a West Indian supply of citric acid, and that they had approached the Institute to this end. During the year under review investigations were taken in hand to produce citric acid from crude sugar by a fermentation process. However, an approach to this Institute from the Co-operative Lime Growers Association in Tobago, for advice on checking microbial growth in lime juice indicated a more profitable approach to the solution of the problem of citric acid production, since it was ascertained that the Lime Growers produce in the course of their distillation of lime oil large volumes of a by-product which contains as much as 8 per cent of citric acid. This by-product is at the moment being run to waste. A similar by-product, though in smaller quantities, is produced in Dominica while Trinidad, apparently, adopts a less efficient distillation process which makes it uneconomical to recover citric acid.

87. An investigation at the Institute showed that the citric acid can be recovered with very simple equipment using locally manufactured chemicals only. A batch of 120 lb. of calcium citrate extracted from Tobago distillation by-products has been despatched to the Citrus Company of Jamaica, Ltd., for conversion into citric acid in their available vacuum plant, on lines advocated by the Institute.

88. The Coconut Growers' Association of Trinidad and Tobago have been assisted during the year under review with advice in margarine production, and responsibility for the regular supply of lactic acid bacteria for this purpose has been accepted by the Hankey Collection.

89. The National Research Council of Canada's Laboratories have requested collaboration with the Institute in the supply and possible concentration and isolation of the growth promoting factor contained in fresh coconut milk.

90. The Copra Manufacturers in Tobago have been advised on the combating of fungus infection of their drying floors.

91. Messrs. Booker Bros., Ltd., of Georgetown, British Guiana, have sought further advice during the year on the susceptibility of paints to fungus contamination under tropical conditions.

92. The Caroni Estate, Ltd., of Trinidad, have requested the assistance of the Institute in the identification of fungus deterioration in stored bagasse.

93. The Committee on Food Production of the Government of Trinidad and Tobago have sought the advice of the Institute in the elimination of calcium sulphate from rum distillery yeast, and in the conversion of grapefruit skins now being wasted, into a silage suitable for cattle feed.

94. The Controller of Imports and Exports for Trinidad and Tobago has been given advice on the nature of spoilage of consignments of condensed milk, spoilage which was shown to have been caused by strains of yeasts.

95. The Liquid Carbonic West Indies Company of Port of Spain has sought the assistance of the Institute in the checking of the microbial content of their soft drink preparations.

APPENDIX I

List of Publications

Papers Published

The Essential Oil of *Zieria Smithii* (Andrews) and its various Forms. By Sir John Simonsen (with F. R. Morrison and A. R. Penfold). *J. Proc. R. S. New South Wales,* 1951, **84**, 196.

Insects and Food. The Application of Science to Pest Control. By Sir John Simonsen. *The Times Review of the Progress of Science,* 1951, No. 1, p. 8.

Triterpenoids. Part III. *cyclo*Artenone, a Triterpenoid Ketone. By D. H. R. Barton. *Journal of the Chemical Society,* 1951, 1444.

The Chemistry of the Pentacyclic Triterpenes. The Formation of 18-iso-β-Amyranol and Germanicol from Lupeol. By T. R. Ames, G. S. Davy, T. G. Halsall, E. R. H. Jones and G. D. Meakins. *Chemistry and Industry,* 1951, No. 35.

The Fatty Acids and Glycerides of Castor Oil. By S. S. Gupta, T. P. Hilditch and J. P. Riley. *Journal of the Science of Food and Agriculture,* 1951, **6**, 245-251.

The Fatty Acids and Glycerides of Okra Seed Oil. B. A. Crossley and T. P. Hilditch. *Journal of the Science of Food and Agriculture,* 1951, **6**, 251-255.

The Influence of Environment upon the Composition of Sunflower Seed Oils. III. Oils from Sunflower Seeds grown in different regions of Australia. By R. E. Bridge, A. Crossley and T. P. Hilditch. *Journal of the Science of Food and Agriculture,* 1951, **10**, 472-476.

Variations in the Composition of some Linolenic-rich Seed Oils. By T. P. Hilditch and Collaborators. *Journal of the Science of Food and Agriculture,* 1951, **12**, 543-547.

The Component Fatty Acids and Glycerides of Tung Oil. By T. P. Hilditch and A. Meldelowitz. *Journal of the Science of Food and Agriculture,* 1951, **12**, 548-556.

Thermal Interchange of Acyl Groups in Triglycerides. By C. Barker, R. V. Crawford and T. P. Hilditch. *Journal of the Chemical Society,* 1951, 1194.

Some Chemical Changes associated with the Thermal Polymerisation of Drying Oils. By C. Barker, R. V. Crawford and T. P. Hilditch. *Journal of the Oil and Colour Chemists' Association,* Vol. XXXIV, No. 371, 1951.

The Composition of Poppy Seed Oils. By R. E. Bridge, M. M. Chakrabarty and T. P. Hilditch. *Journal of the Oil and Colour Chemists' Association,* Vol. XXXIV, No. 374, 1951.

Rational Grading of Seed Oils. By T. P. Hilditch. *Chemistry and Industry,* 1951, 846.

The Enzymic Synthesis and Degradation of Starch. Part XII. The Mechanism of Synthesis of Amylopectin. By P. N. Hobson, W. J. Whelan and S. Peat. *Journal of the Chemical Society,* 1951, 596.

The Enzymic Synthesis and Degradation of Starch. Part XIII. Improved Methods for the Fractionation of Potato Starch. By P. N. Hobson, S. J. Pirt, W. J. Whelan and S. Peat. *Journal of the Chemical Society,* 1951, 801.

The Enzymic Synthesis and Degradation of Starch. Part XIV. R-enzyme. By P. N. Hobson, W. J. Whelan and S. Peat. *Journal of the Chemical Society,* 1951, 1451.

Enzymic Synthesis and Degradation of Starch. Part XV. β-Amylase and the Constitution of Amylose. By S. Peat, S. J. Pirt and W. J. Whelan. *Journal of the Chemical Society*, 1952, 705.

Enzymic Synthesis and Degradation of Starch. Part XVI. The Pyrification and Properties of the β-Amylase of Soya Bean. By S. Peat, S. J. Pirt and W. J. Whelan. *Journal of the Chemical Society*, 1952, 714.

Enzymic Synthesis and Degradation of Starch. Part XVII. Z-Enzyme. By S. Peat, G. J. Thomas and W. J. Whelan. *Journal of the Chemical Society*, 1952, 722.

The Determination of Starch by Acid Hydrolysis. By S. J. Pirt and W. J. Whelan. *Journal of the Science of Food and Agriculture*, 1951, No. 5, 224-228.

Birefringence Iodine Reactions and Fine-Structure of Waxy Starches. By F. Baker and W. J. Whelan. *Journal of the Science of Food and Agriculture*, No. 10, 444.

The Biological Transformations of Starch. By S. Peat. *Advances in Enzymology*. 1951, Vol. XI.

The Amylase of Clostridium butyricum. By W. J. Whelan and H. Nasr. *Biochemical Journal*, 1951, **48**, 416.

End-Products of the Action of Salivary α-Amylase on Amylose. By P. J. P. Roberts and W. J. Whelan. *Biochemical Journal*, 1951, **49**, lvi.

Selective Inhibition of Enzymic Impurities Associated with Potato Phosphorylase. By J. M. Bailey, G. W. Thomas and W. J. Whelan. *Biochemical Journal*, 1951, **49**, lvi.

Anhydrides of Polyhydric Alcohols. Part XV. The Reactions of Sodium Iodide and Lithium Chloride with Dimethanesulphonyl and Ditolueme-p-sulphonyl Derivatives of the 1:4-3:6-Dianhydrides of D-Mannitol, D-sorbitol and L-iditol. By L. F. Wiggins and D. J. C. Wood. *Journal of the Chemical Society*, 1951, 1180.

Ethylidene Derivatives of Mannitol. By E. J. Bourne, G. T. Bruce and L. F. Wiggins. *Journal of the Chemical Society*, 1951, 2708.

Sugar Cane Wax. Part II. A Survey of Potential Wax Yields throughout the British Caribbean Areas. By L. F. Wiggins. *Proceedings of the British West Indies Sugar Tech. Meeting*, 1950.

Sugars. By L. F. Wiggins. *Annual Report of the Progress of Applied Chemistry.*

Recent Trends in the Sugar Industry of the British West Indies. By L. F. Wiggins. *British Journal of Nutrition*, 1950, **4**, 69.

Detection of Sugars by Paper Chromatography. By R. J. Bayly, E. J. Bourne and M. Stacey. *Nature*, 1951, **168**, 510.

The Synthesis of Uronic Acids. By A. S. Barker, E. J. Bourne and M. Stacey. *Chemistry and Industry*, 1951, 970, No. 45.

The Striga Germination Factor. Part II. Chromatographic Purification of Crude Concentrates. By R. Brown, A. W. Johnson, E. Robinson and G. J. Tyler. *Biochemical Journal*, 1952, **50**, 593.

The Pharmacology of some Basic Ketones and Related Compounds. By P. B. Marshall, Nazeer ud din Ahmad and R. E. Weston. *British Journal of Pharmacology*, 1952, **7**, 85.

The Chemistry of the Mitragyna Genus. Part II. Synthesis of 7-Methoxy-1:2-Dimethyl-β-carboline. By J. W. Cook, J. D. Loudon and P. McCloskey, *Journal of the Chemical Society*, 1951, 1203.

Caffeine in Cacao beans. By W. G. C. Forsyth. *Nature*, 1952, **169**, 4288.

The Changes in Cacao Polyphenolic Substances during Fermentation. By W. G. C. Forsyth. *Biochemical Journal,* Dec. 1951, Vol. 5-iii, No. 2.

Our Approach to the Study of Cacao Fermentation. By W. G. C. Forsyth and J. E. Rombouts. *Cocoa Conference, London,* 1951.

Papers in the Press.

Pyridazone Derivatives with Pharmacological Action on the Nervous System. By M. R. A. Chance, I. Wadja and R. Weston.

Observations on the Microflora of Fermenting Cacao Beans in Trinidad. By J. E. Rombouts. *Proceedings of Soc. App. Bact.,* 1952.

Cacao Polyphenolic Substances, I. By W. G. C. Forsyth. *Biochemical Journal.*
Cacao Polyphenolic Substances, II. By W. G. C. Forsyth. *Biochemical Journal.*

The Extraction of Cacao Pigments. By W. G. C. Forsyth and J. E. Rombouts. *Journal of the Science of Food and Agriculture,* 1952.

Food and Fodder Yeast. Part of "Biologia et Industria" Yeasts, edited by W. Roman, Ph. D. By A. C. Thaysen.

APPENDIX II

Patents Granted.

Improvements relating to Levulinic Acid. W. N. Haworth and L. F. Wiggins. B.P. 583, 533.

Improvements relating to the manufacture of 5 hydroxymethyl furfural or Levulinic Acid. W. N. Haworth and L. F. Wiggins. B. P. 591, 858.

Improvements relating to the manufacture of 1:4-3:6-dianhydrides of mannitol and sorbitol. W. N. Haworth and L. F. Wiggins. B.P. 600, 870.

Improvements relating to synthetic resins. W. N. Haworth and L. F. Wiggins. B.P. 619, 500.

Improvements relating to the manufacture of 5 hydroxymethyl furfural. W. N. Haworth and L. F. Wiggins. B.P. 600, 871.

Improvements relating to the manufacture of Alkyl ethers of dianhydrides of hexahydric alchohols. W. N. Haworth and L. F. Wiggins. B.P. 599, 048.

Sulphanilamide pyridazones. W. N. Haworth and L. F. Wiggins. B.P. 600, 532.

Sulphanilamide thiazoles. W. N. Haworth and L. F. Wiggins. B.P. 619, 693.

Patent Applications.

Alkyl and Dialkylamine alkyl Pyridazones. W. N. Haworth and L. F. Wiggins. No. 9691.

Manufacture of analgesics from Pyradazine and Pyridazone derivatives. W. N. Haworth and L. F. Wiggins. No. 33482/1948.

Improvement in or relating to apparatus for decorticating nuts with hard shells. H. Curtis and E. F. Mactaggart. No. 3506/1950.

A process for the manufacture of Refined Sugar Cane Wax. L. F. Wiggins. No. 19215/1949.

A process for the Refining of Sugar Cane Wax. L. F. Wiggins and B. K. Davison. No. 13772/1951.

A Process for the Manufacture of Certain Lactic Acid Derivatives from Carbohydrate Materials. L. F. Wiggins and A. F. Thomson. No. 16792/1951.

Colonial Social Science Research Council Eighth Annual Report (1951-1952)

Institute of Advanced Legal Studies,
25, Russell Square,
London, W.C.1.

7th July, 1952.

SIR,

I have the honour, on behalf of the Colonial Social Science Research Council, to transmit to you the Eighth Report of the Council, covering the period from 1st April, 1951, to 31st March, 1952.

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

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

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

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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

EIGHTH ANNUAL REPORT

I. INTRODUCTORY

The Council held five meetings during the year 1st April, 1951 to 31st March, 1952, and three meetings of the Committees took place. Much of the work of the Committees was conducted by correspondence.

2. Sir Alexander Carr-Saunders, the Chairman of the Council since its inception, resigned his chairmanship in July, 1951, on taking over the chairmanship of the Inter-University Council for Higher Education in the Colonies. This report accordingly includes a retrospect of the work achieved by the Council during the period of his chairmanship.

3. Professor Sir David Hughes-Parry, Director of the Institute of Advanced Legal Studies in the University of London accepted the Secretary of State's invitation to be Chairman of the Council.

4. Professor Raymond Firth, who was the Council's first Secretary, and has been closely associated with its work since its inception, resigned his membership on leaving the United Kingdom for a sabbatical period in Australia, where he is advising the Australian National University. Professor Firth's contribution to the work of the Council included research surveys which formed the basis of its programme of studies in West Africa and Malaya, the supervision of a number of projects and the training of a number of postgraduate students assisted from Colonial Development and Welfare funds.

5. Professor R. H. Tawney resigned from the Council on retirement from his professorship.

6. Professor Sir David Hughes-Parry visited the University Colleges in West Africa on behalf of the Inter-University Council for Higher Education in the Colonies.

7. Professor Vincent Harlow, a member of the Commission appointed by the Secretary of State to make proposals for constitutional reforms in British Guiana was made a C.M.G. in the New Year's Honours List, 1952.

II. GENERAL

8. Increases in the cost of living in the Colonial territories have been reflected in the number of supplementary schemes the Council has had to recommend. Moreover, since 1st October, 1951, the Council has had to operate within the allocation of £325,000 for social science research, which sets the limit of expenditure from the central research allocation of Colonial Development and Welfare funds until the end of the term of the Colonial Development and Welfare Act of 1945 on 31st March, 1956. A little over £200,000 remained unallocated at 31st March, 1952. From this residue a number of known commitments have to be met in respect of the regional Institutes, the continuation of existing schemes, and the financing of others now at an advanced stage of planning. It is, also, essential to maintain a small reserve to meet unforeseen expenses towards the end of the period of the Act. Consequently, the Council has found it necessary to exercise great restraint in the making of new schemes and to refuse applications for grants for new projects which are not already in the receipt of a great measure of financial support from Universities, Research Foundations or Colonial Governments.

9. The recruitment position for experienced research staff shows signs of considerable improvement. Difficulty is, however, still being experienced in the recruitment of senior staff capable of organising research and in certain special categories, such as demography and law.

10. Of the 15 postgraduate students who completed their training in the United Kingdom before being assigned to field projects, three are still in the field and the remainder are now writing up their fieldwork at the Universities to which they have been attached. No Colonial Research Fellowships or Studentships in the Social Sciences have been awarded this year.

11. Of the five American social scientists appointed under the special scheme for training American social scientists at British Universities, two are still in the field in Kenya and one has been appointed to the staff of the East African Institute of Social Research. Two are now writing up their material.

III. RETROSPECT

12. In his first report submitted in 1945 to the late Colonel Oliver Stanley, the Chairman of the Council suggested that there was urgent need for a wide range of intensive research into the individual cultures and languages of Colonial peoples in addition to various institutional studies. Of the latter the Council selected the following for special mention :—

(*a*) Surveys of social and economic conditions in urban and in rural areas.

(*b*) Comparative studies of local government.

(*c*) Studies of the social and economic effects of migratory labour in Africa.

(*d*) Studies of land tenure in relation to agriculture and social structure.

(*e*) Studies of Colonial administrative law, particularly in respect of procedure in native courts.

(*f*) Studies of political development in " plural " communities.

(*g*) Sample surveys of literacy in relation to programmes of mass education.

13. In the ensuing years the Council commissioned a number of research surveys of particular areas, and valuable reports were presented to the Council by Professor Raymond Firth (Malaya and West Africa generally), Professor Forde (Gambia), Dr. Stanner (Uganda and Tanganyika), Professor Schapera (Kenya) and Dr. Leach (Sarawak). The seven-year plan of the Rhodes-Livingstone Institute prepared by Dr., now Professor Gluckman was issued in 1945 and provided a programme of research for Central Africa. These research surveys were widely disseminated and served not only as the basis for the first assessment of priorities by the Council, but as a means of inviting scholars to concern themselves in Colonial research problems which combine academic interest and administrative value. The Council soon felt, however, that the detailed organization and planning of research was a function that should be taken over by the appropriate regional institute of social research, leaving to the Council itself no more than the general planning and supervision of work from the standpoint of the Colonial Empire as a whole (Third Annual Report, paragraph 10). In the first two or three years of the Council's existence, therefore, the organization and functions of the regional institutes received much of its attention. A pattern was ready to hand in the Rhodes-Livingstone Institute which was founded in 1938 with assistance from Government and private interests to conduct social research in Central Africa, but with the expansion of higher education in the Colonies, the attachment of the infant

Institutes to Colonial University Colleges was made possible. This attachment was made not only to provide the institutes with common services and the more intangible advantages of contact with professional colleagues, but with an eye to their future development into postgraduate departments of the Colleges which would attract research workers and provide the colleges with teaching material. An account of the work of the Institutes during the year under review is included in Annexes I–IV of this report. Some £525,000 has been allocated to the five Institutes established or maintained with assistance from Colonial Development and Welfare funds.

14. Some other experiments in research organization were made; for example, the temporary appointment of anthropologists to work directly under Government supervision, as in Kenya; and the looser attachment of research workers to Colonial Governments, as in Sarawak, Nigeria and Singapore. The lesson learnt from these experiments was that the pay and conditions of service of individual workers employed under so-called Government administered schemes should be made as simple as possible, and that unless the worker's investigation area was near his administrative headquarters, the financial administration of research schemes was best entrusted to academic institutions. Experience showed, nevertheless, that the full co-operation of Colonial Governments involving careful preparation of the mechanics of investigations in consultation with them was essential to their success. Much is owed to the personal interest and sympathy of Colonial Service Officers who have gone out of their way to help field workers in material ways and have helped them considerably with information and advice.

15. Another lesson learnt in the course of the last eight years is the need to provide financially for writing up immediately after a worker has returned from the field and to limit the contents of the report to the Council to what can reasonably be expected to be produced within the time allotted. Much of the delays of publication of the result of work commissioned by the Council in its earlier years has been due to the fact that workers, especially the more experienced ones, have on their return from the field been absorbed in University teaching which under the recent expansion has left them little leisure in which to complete their reports.

16. Of the main topics listed in the Council's First Report, we can point to considerable progress in the intensive study of the cultures of Colonial peoples. As a result of Dr. Leach's pilot survey of research needs in Sarawak, investigation of the Iban, Land Dyak and Melanau peoples have been completed and are being written up. The Sarawak Museum under Mr. Harrisson's direction is continuing the programme with a study of the Malay people of Sarawak. In Kenya, following Professor Schapera's programme, fundamental ethnographic studies of the Gusii, Teita, Turkana and Galla peoples have been accomplished or are in train, and some material has already been published. Material on Luo social structure has been collected and published by a Colonial Research Fellow and work on the Kikuyu Family by a woman ethnographer is in progress. In Uganda and Tanganyika a number of the ethnographic studies recommended by Dr. Stanner are in progress, undertaken by East African Institute staff, by independent workers associated with it and by Fulbright Fellows. An impressive amount of information about the people of Northern Rhodesia and Nyasaland has been collected by the Rhodes-Livingstone Institute and an increasing number of important publications is being issued. In West Africa a vast amount of work remains to be done but a start has been made in Nigeria and the Cameroons with investigation of the Nsaw of Bamenda Province, the Hausa and pagan peoples of Zaria Province, the Idoma of Benue Province and Ibo groups in Owerri Province. The Council has associated itself with an international programme of research among the Nomadic Fulani. In the Gold Coast work is in progress in the North-west among the so-called Lobi. Dr. Little's work on the Mende in Sierra Leone has now been published. In the

Gambia a comprehensive study of the social and economic institutions of its peoples by Dr. Gamble is in progress. In West Africa, however, the Council and the West African Institute of Social and Economic Research are not alone in the field, for members of the staff of the University College of the Gold Coast are engaged in anthropological research; a systematic programme of work has been undertaken under the auspices of University College, London; and the area has attracted Scarbrough and Horniman students and American workers, notably those trained by Northwestern University. In the Caribbean area a study of the Arecuna and Akowoio tribes of British Guiana is in progress.

17. As to the institutional studies, social and economic surveys have been attempted in Zanzibar, Aden, Uganda and Nigeria and in rural areas of Sierra Leone and Jamaica.

18. With the establishment of the African Studies Branch in the Colonial Office work on local government received an impetus exemplified in Lord Hailey's survey of Native Administration in Africa and in material published in the Journal of African Administration. The Rhodes-Livingstone Institute has also published studies of native administration problems.

19. The effects of the system of migratory labour has been one of the central themes of the Rhodes-Livingstone Institute's work and the East African Institute has recently completed field investigations of immigrant labour in Uganda.

20. The important subject of Land Tenure has been covered to some extent by the Rhodes-Livingstone Institute: in addition, Dr. Sheddick's studies in Basutoland and Mr. Allott's in the Gold Coast promise to be of great importance. Dr. Meek is at present engaged in a detailed synoptic study of land law in British Africa. Law as practised in the urban courts of Northern Nigeria has been studied and Islamic Law has been the subject of two investigations. A start has been made in the study of political development in plural communities among the Chinese in Kuching and in Singapore, but much remains to be done in this field. Literacy surveys have not been attempted in view of the expansion of departmental educational research and the work of the new Institutes of Education established at colonial University Colleges. Research into intelligence and aptitude testing has been promoted in the West Indies and West Africa.

21. Since its inception, the Council has recommended the allocation of Colonial Development and Welfare funds totalling over £950,000 of which £525,000 has been allocated to five Institutes in the Colonial territories. The balance has been allocated to institutions, such as Colonial Museums and research Institutes in the United Kingdom for special projects, and to individuals for training, fieldwork, study tours, and documentary research. Over 120 schemes have been made, and the majority of them have involved the submission of reports to the Council or the preparation of publishable material.

A provisional bibliography at Appendix V of this Report shows the published output from Colonial Development and Welfare-financed research in the social sciences to date. However, the bibliography does not give a complete picture of the output. Much work has been done in the form of unpublished memoranda to Governments and in the supply of teaching material to University teachers charged with the training of Colonial Service cadets and Second Devonshire Course men.

Another form in which a return on the investment of Colonial Development and Welfare funds has been made is the training of a cadre of young research workers and University teachers in disciplines of importance to the development of colonial territories, to replace the gaps brought about by the war in the learned

professions. This cadre now includes several West Indians and Africans. The Council has attached much importance to increasing the participation of colonial scholars in the study of colonial history, languages and cultures.

IV. PROGRESS OF COLONIAL STUDIES IN BRITISH UNIVERSITIES

22. Reference was made in the Council's sixth Annual Report to research carried out independently in institutes of higher learning in the United Kingdom and Commonwealth. Many University Departments are now associated with the Colonial Social Research Council in the supervision of schemes financed from Colonial Development and Welfare funds and through the provision of special facilities for writing up material collected in the field.

The Institute of Colonial Studies and the Institute of Social Anthropology at Oxford University, Nuffield College, Oxford, the London School of Economics, the School of Oriental and African Studies, the Department of Anthropology at University College, London, the Department of Education at the University of Edinburgh, the Colonial Department of the Institute of Education at London University, the Department of Anthropology at Manchester University, and the Department of Archaeology and Anthropology at Cambridge University have all materially assisted in these ways and some have arranged for members of their teaching staffs to undertake research projects in the colonial territories and have given them leave of absence to do so.

23. Amongst the independent research activities of Universities in the United Kingdom attention might be drawn to the bibliographical work of the Institute of Colonial Studies, research in Colonial History and Administration by Fellows of Nuffield College, the award of scholarships by Cambridge University to field workers in anthropology, including those assisted from Colonial Development and Welfare funds, the work of the Department of Anthropology of the University of Manchester, which is closely associated with the Rhodes-Livingstone Institute on Central African studies, work on race relations carried out under the auspices of the Department of Anthropology of the University of Edinburgh, work on the languages of the South Pacific and North Borneo at the School of Oriental and African Studies and fieldwork in Nigeria assisted by University postgraduate studentships under the auspices of University College, London. Several holders of Treasury studentships for the study of foreign languages and cultures are carrying out studies in Colonial territories under the supervision of the Universities sponsoring them.

24. The Department of Anthropology of the Australian National University is now engaged on three research projects, namely an analysis of the social organization and types of society occurring in the highlands of New Guinea, a study of the appearance of cargo cults in the Pacific Islands, and the continuation of a study of the Pacific islander in commerce and industry originally suggested by the South Pacific Commission. The University of California plans to collaborate in the first project with the Australian National University.

V. PROJECTS IN PROGRESS

Projects undertaken by International African Institute

25. *Handbook of African Languages:* During the current year one volume of the four-volume general survey has been published (La Langue Berbère, Andre Basset); one is now in the press (*Languages of West Africa*, by D. Westermann and M. A. Bryan); one is now being prepared for press (*Languages of North-East*

Africa, by A. W. Tucker and M. A. Bryan) and the fourth (*Languages of Bantu Africa*) will be completed by the end of this year. A special study by Professor Doke on the *Bantu Languages of Southern Africa*, is now in the press.

26. *Linguistic Survey of the Northern Bantu Borderland:* This project (in which the Belgian and French Governments collaborated) has been completed and the report is being prepared for press.

27. *Ethnographic Survey of Africa:* The last year has seen the completion of a number of sections of the Survey (see bibliography) and four sections are in the press at the moment. Mr. H. G. Gunn returned from Northern Nigeria in the summer of 1951 with a quantity of material which is now being prepared for press.

28. *Survey of African Marriage and Family Life:* This study, sponsored jointly by the International African Institute and the International Missionary Council, and financed by grants from Colonial Development and Welfare funds and the Carnegie Corporation, has now been completed and the report is now in the press. The report which includes a section by each of the three investigators, together with an introduction by Mr. A. Phillips, Director of the Survey, is to be published in one volume.

Other African Projects

29. *Study of French Administration in North Africa:* Miss S. E. Crowe who is writing up the result of her investigations under the supervision of the Colonial Studies Committee, Oxford University, has made progress on the economic chapters of her book which will, it is hoped, be privately published.

30. *Land Tenure in British Africa:* Dr. C. K. Meek has already submitted two sections of his comprehensive work on land tenure and aspects of family law in British African territories.

31. *Islamic Law in Africa:* The report by Dr. Schacht, Reader in Islamic Law at the University of Oxford, on the application of Islamic Law in Northern Nigeria has been widely distributed by the Institute of Colonial Studies and by the Government of Nigeria for official purposes.

32. The report by Mr. J. N. D. Anderson, Reader in Islamic Law at the University of London, on his synoptic survey of the present position as regards Islamic Law in the British African territories and Aden is now in the press, and will issue in the Colonial Research Publications series.

33. *History of African Administration:* Mr. R. E. Robinson, Fellow of St. John's College, Cambridge, has completed a portion of his work on the history of British Administration in Africa from the time of Lord Lugard.

34. *Socio-Economic Survey of Zaria, Nigeria:* Mr. M. G. Smith has completed a thesis on social change among selected Hausa communities in Zaria for which he was awarded a Ph.D. His report has been submitted to the Government of Nigeria and publication is under consideration. He has nearly completed similar reports on pagan communities in Zaria. He has worked under the supervision of Professor Daryll Forde.

35. *Socio-Economic Survey of Mba-Ise, Owerri, Nigeria:* Mr. E. W. Ardener has returned to the United Kingdom from Nigeria and is now writing up his report at the London School of Economics. He has been appointed to the staff of the West African Institute of Social and Economic Research.

36. *Socio-Economic Survey of Oshogbo, Nigeria:* Mr. W. B. Schwab, one of the American sociologists selected under the special scheme referred to in paragraph

11, who is now teaching at Haverford College, has completed his first draft of the first volume of his report on the results of his survey. This is now being revised for publication in consultation with Professor Daryll Forde. He has also prepared for publication a paper on the religious composition of Oshogbo.

37. *Delta Trade and Politics in the Nineteenth Century, Nigeria:* Reference is made to Dr. K. O. Dike's work in the report of the West African Institute of Social and Economic Research (See Appendix II).

38. *Economic Position of Women in the Cameroons (Bamenda):* Dr. Phyllis Kaberry's report will shortly issue in the Colonial Research Publications series.

39. *Field Study of the Nomadic Fulani of Northern Nigeria:* Mr. D. J. Stenning is now in the field in Nigeria and his first reports indicate that his first contacts with the Fulani have been happy. The Government of Nigeria have attached Mr. F. de St. Croix to the project which is being carried out in co-operation with the International African Institute who have already sent another worker to Nigeria.

40. *Ethnographic Study of the Idoma People of Benue Province:* Mr. R. G. Armstrong has concluded his first field tour and is now on study leave at the Institute of Social Anthropology, Oxford. The project is under the supervision of Professor Evans-Pritchard and is administered by University College, Ibadan.

41. *Ethnographic Study of the Lobi, Gold Coast:* Mr. Jack Goody has completed his first field tour and is now at Cambridge writing an interim report on his investigations under the supervision of Professor Fortes.

42. *Psychological Testing in the Gold Coast:* Dr. Geoffrey Tooth, whose project was described in the last Annual Report, is working in close co-operation with the educational authorities in Nigeria. The project is administered by the University College of the Gold Coast and is under the supervision of Professor Sir Godfrey Thomson and Dr. Fraser Roberts.

43. *Study of Proprietary Law in the Gold Coast:* Mr. A. N. Allott, a Lecturer at the School of Oriental and African Studies, has completed an investigation of proprietary law in the Gold Coast, part of which was financed by the School. He is now writing up his report which promises to be of great interest and value under the supervision of Professor Vesey-Fitzgerald.

44. *Socio-Economic Survey of Rural Communities of the Colony Peninsula, Sierra Leone:* Miss E. M. Richardson and Mr. G. R. Collins have returned to the United Kingdom to write up their report.

45. *Sociological Research, Gambia:* Dr. D. P. Gamble has returned to the United Kingdom to write up his investigations of rural communities in the Gambia and when he has completed this report will return to Gambia at the invitation of the Government to carry out an investigation of the Fulla and Serahuli tribes. A part of the cost of this new investigation is being defrayed by the Government of the Gambia. His work is being supervised by Professor Daryll Forde.

46. *Linguistic Research in the Somaliland Protectorate:* Mr. B. E. Andrzejewski has returned to the School of Oriental and African Studies where he has been writing up the results of his investigations under the supervision of Professor J. R. Firth. A report on Somali orthography has been submitted to the Protectorate Government.

47. *Study of the Kikuyu Family, Kenya:* Dr. Jearne Fisher is pursuing her studies of the Kikuyu family, with special reference to women's activities, under the supervision of Dr. Audrey Richards.

48. *Study of the Teita, Kenya:* Two American anthropologists, Mr. Alfred Harris and his wife Mrs. Grace Gredys Harris, will shortly complete their field investigations of the Teita.

49. *Anthropological Study of the Galla of North-Eastern Kenya:* Mr. P. T. W. Baxter, one of the last students selected for postgraduate training, is now engaged in a study of the Borana Galla of North-Eastern Kenya under the supervision of Professor E. E. Evans-Pritchard.

50. *Anthropological Study of the Turkana, Kenya, and Jie, Uganda:* Mr. Philip Gulliver who has returned to the London School of Economics to finish his writing-up, has published a preliminary monograph on the Turkana and has published articles on various aspects of the Karamojong peoples. He is now engaged in a monograph on the Turkana and Jie which will shortly be completed under Professor Schapera's supervision.

51. *Anthropological Study of the Lugbara, Uganda:* Mr. J. F. M. Middleton, whose investigation is assisted with funds made available by the Goldsmiths' Educational Trust, has completed his second tour in Uganda and has returned to Oxford University to prepare a final report under Professor Evans-Pritchard's supervision, and an interim report for the Uganda Government on Lugbara labour migration.

52. *Anthropological Study of the Alur and Jonam, Uganda:* Mr. Aidan Southall, who started his investigations as a Colonial Research Fellow and subsequently joined the staff of the East African Institute of Social Research, is now on study leave at the London School of Economics where he is completing a thesis under Professor Schapera's supervision.

53. *Anthropological Study in the Bwamba-Komjo area, Uganda:* Mr. E. H. Winter, an American anthropologist, is still in the field. He will shortly join the staff of the East African Institute of Social Research.

54. *Anthropological Study of the Toro, Uganda:* Mr. Brian Taylor, whose work is supervised by Dr. Audrey Richards, is still at work in the Fort Portal area.

55. *Study of the Barabaig, Tanganyika:* Mr. Gordon Wilson, a Canadian postgraduate student, is carrying out his investigation in association with the Tanganyika Government establishment of sociologists under the supervision of Dr. Audrey Richards. He has submitted an interim report to the Government.

56. *Legal Studies in Northern Rhodesia:* Mr. Arnold Epstein, who returned to the United Kingdom some months ago to write up the results of his investigations, has completed the first draft of his report which has been submitted to the Northern Rhodesian Government. His is now working under Professor Gluckman's supervision at the University of Manchester.

57. *Social Survey of Zanzibar:* A number of interim reports have been submitted by Professor Edmund Batson to the Government of Zanzibar and work on the analysis of the material is still in progress.

58. *Study of Administration by Native Authorities, Nyasaland:* It has been decided to issue Dr. Lucy Mair's report to the Colonial Social Science Research Council as a paper in the Colonial Research Studies series.

59. *Native Land Tenure in Basutoland:* Dr. Vernon Sheddick's report which was successfully submitted as a Ph.D. thesis, has now been submitted to the Government of Basutoland and arrangements for publication are under consideration.

South-East Asia and Pacific

60. *Anthropological Studies in Sarawak:* Dr. W. Geddes, who is now teaching at Auckland University College, has nearly completed the first draft of his report on the Land Dyak engaged in paddy cultivation and is also preparing a shorter paper on Land Dyak land tenure.

61. Mr. H. S. Morris, an Assistant Lecturer at the London School of Economics, is writing up his investigations of a Melanau community engaged in sago production and has made some of his results available as an address to the Royal Anthropological Institute. He will shortly join the staff of the East African Institute of Social Research as a sociologist to study Indian communities in East Africa.

62. Mr. J. D. Freeman has returned to the United Kingdom and is writing up his field work at Cambridge University. In view of the richness of the material collected, he has been granted an extra period of writing-up leave.

63. **Sarawak Museum Project:* A grant has been made to the Government of Sarawak to assist an investigation by the Sarawak Museum supervised by the Curator Mr. Tom Harrisson into the social and economic life of the Malay community.

64. *Sociological Studies in North Borneo:* Miss Monica Glyn-Jones, a geographer, has returned to the United Kingdom and is writing up her report at the University of Cambridge under the supervision of Professor Debenham, with assistance from Dr. Leach on the sociological aspect of it.

65. *Sociological Studies in Singapore:* Mr. Maurice Freedman, who is now a Lecturer at the London School of Economics, is writing up the results of his investigations of Chinese family structure. Miss Djamour's report on her work on Malay family structure has unfortunately been held up by illness.

66. Mr. Alan Elliott has returned to the United Kingdom to write up his study of the religious associations of the Singapore Chinese, and has already completed a rough draft of his report. His work is being supervised, in Professor Raymond Firth's absence, by Dr. Leach.

67. *Linguistic Research in Fiji, Tonga and Solomon Islands:* Mr. G. B. Milner has submitted a draft Fijian Grammar to the Fiji authorities and publication is under consideration. Arrangements have been made for a number of the recordings he was able to collect to be used by the Fiji Broadcasting Station.

68. *Educational Research in Fiji and the Western Pacific:* The Institute is now being established with a Principal (Mr. R. S. Adam, M.A., Dip. Ed.), two Research Assistants (Mr. Aud Chand, M.A., Dip. Ed., and Mr. Eliki Seru), and two clerks. The staff of the Institute will work on standards of attainment and methods of selection, and a study of teaching methods and their application to the needs of the South Pacific. Temporary buildings will probably have to be used to start with.

Caribbean

69. *Psychological Testing in the West Indies:* Reports have been presented by Mr. B. J. Bedell and Mr. A. Deans Peggs, and articles have already been published in scientific journals. Mr. Deans Peggs and Mr. Bedell were awarded Ph.D's by the University of Edinburgh for this work.

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*New project started in the year under review.

70. *Social Survey of Jamaica:* Miss Edith Clarke's work on the writing up of the survey has unfortunately been delayed by her work for the Government of Jamaica on hurricane relief.

71. Dr. Madeline Kerr's work on personality conflicts in *Jamaica* is now in the press.

72. *Friendly Societies in the West Indies:* A report submitted in 1949 by Mr. A. F. Wells and Mrs. D. Wells will shortly be published by the Colonial Office.

73. *Sociological Research in British Guiana:* Mr. R. T. Smith is now in the field and is making a study of a Guianese coastal village under the supervision of Professor Fortes.

74. Miss Audrey Butt, whose work has been assisted by grants from the International Federation of University Women and the Central Research Fund of the University of London, has submitted an interesting interim report on her investigations of the Arecuna and Akowoio peoples. The project is supervised by Professor E. E. Evans-Pritchard.

75. *Demographic Survey:* The West Indian volume of the late Dr. Kuczynski's *Demographic Survey of the British Colonial Empire*, which is being edited by Dr. B. Long, is in the press and will, it is hoped, issue in 1953.

VI. THE STANDING COMMITTEES OF THE COUNCIL

76. 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.
Professor D. V. Glass, B.Sc. (Econ.), 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 Africa 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-Fitzgerald, M.A., LL.D., University of London.

Mr. E. C. Willis of the Research Department is now Secretary of these Standing Committees.

APPENDIX I

EAST AFRICAN INSTITUTE OF SOCIAL RESEARCH

Makerere College, University College of East Africa

ANNUAL REPORT

April 1st, 1951—March 31st, 1952.

Buildings

1. The Institute buildings were ready for occupation by the beginning of August, 1951. They consist of a small three-roomed office, six four-roomed flats with servant's quarters and a garage for four cars. The buildings and their interior fittings are of an austerity standard but the site presented by the College authorities is a fine one and commands a beautiful view of Kampala and the surrounding hills. The Institute still rents one of the College houses.

2. Since occupying its present quarters the Institute has given hospitality to twenty research students consisting either of members of the staff or holders of Colonial Research grants, Scarbrough or Fulbright grants. The guest accomodation has been used for periods of a month to four months by Fellows wanting to work up their material or by newly arrived students preparing themselves to go into the field. It was initially difficult to persuade Fellows to take time off from their field work to write up their notes, but the value of such periods is now increasingly recognised and the provision of such accommodation is certainly one of the important needs the Institute should cater for. (See Paragraph 3 below). The buildings were also used for the first time for an informal conference in the early part of January, 1952. Its undoubted success was at least partly due to the fact that all members of the conference could be accommodated in the one block.

3. It is obvious, however, that with the present rate of expansion of the staff and the increasing number of other research workers who want to use our accommodation and other facilities, the buildings will soon become completely inadequate. By the middle of 1952, at least two additional offices will be needed, one for the newly appointed linguist and his staff and one for the psychologist and his assistant. The Director at present has an office in her own flat, but this cannot be a permanent arrangement. The Institute library is at present housed in half of one of the residential flats but this accommodation will shortly be needed for residential purposes and therefore a new library room will be required. It has been proved that adequate store-rooms are essential in the case of an Institute of which the staff is mainly occupied in field work. Rooms are required for storing camp equipment and for the personal luggage of research workers who have to vacate a flat so that it may be used by someone else during their absence. With the four new appointments made this year, it will also be necessary to have new residential accommodation, since there are six flats available to house five married couples and four single people. This leaves no guest accommodation although the Institute has to be prepared to provide hospitality to other members of its staff and to at least eight other field workers and their families who are attached to the Institute for academic supervision. Funds for this purpose will therefore be required.

Library

4. The library has grown during the past year and it now forms a satisfactory lending library for field anthropologists. The collection of Government publications is also becoming useful. The library is now being strengthened on the economic, psychological and linguistic sides. Main works of reference are still housed in the College Library.

5. Work is continuing on an East African bibliography and the material for the Uganda bibliography is nearing completion. Periodicals are being indexed under subject and tribal headings. A press cutting collection from the local press (European and African) is being prepared and should ultimately be valuable.

Finance

6. Estimates for 1952 submitted for approval through the Colonial Social Science Research Council total £23,396 or £1,447 more than shown in the quinquennial estimates. The increase is due mainly to the payment of 20 per cent. cost of living allowance on all salaries. No provision for a cost of living allowance was made in the original quinquennial estimates, but in view of the fact that officials of the Protectorate Government and staff of Makerere College were granted this allowance, it was felt that the Institute must, of necessity, follow suit. Cost of living allowance to 31.12.51 was met from savings made during the earlier part of the scheme, but if this allowance remains in force, a total of approximately £7,560 will have to be found from the beginning of 1952, until 30.6.55 when Scheme R.409 expires.

7. In January, 1952, it was found necessary to make increases in the salary scale of both Junior and Senior Research Fellows owing to the wide discrepancy in salary scales between the West African and East African Institutes respectively. The starting point on the Junior Research Fellow scale was increased from £605 p.a. to £655 p.a., and that on the Senior Research Fellow scale from £695 p.a. to £795 p.a. Annual increments of £25 instead of a biennial increment of £50 were also approved.

Staff

8. The staff now consists of two secretaries, four anthropological research Fellows, three senior and one junior, two urban sociologists, one linguistic research assistant and one sociological research asistant. A psychologist has been appointed and will begin work in March; a linguist, who will begin work in April; an economic historian, who will arrive in early June; and an Indian sociologist to start work in July. Another anthropologist has also been appointed and will take up his duties in January, 1953.

9. Several members of the staff after an initial learning period have now become experienced field workers able to take charge of more ambitious research projects in the future. Two and possibly five research Fellows who are completing their contract are signing on for a new period and it is felt that every effort should be made to encourage senior Fellows to remain on the staff of the Institute in this way. It is for this reason that they receive a larger increase in salary by the new provision given in paragraph 7.

10. Discussions have been held on the possibility of arranging joint publication of material on common problems in different areas and Fellows have shown themselves willing and anxious to work on joint schemes of this kind and to experiment in new types of comparative work. Research students attached to the Institute for supervision have also been interested in co-operating in work of this kind.

11. Experience has shown the value of the policy of starting the work of a new Institute by means of preliminary anthropological studies in different areas. Anthropological students who have mostly specialised in the study of African society are able to start work with much less preliminary preparation than other social scientists and are able to proceed comparatively quickly on their studies of particular societies. These form the necessary background for subsequent investigations of special problems. It is now felt that the time has come to add other specialists to the staff and hence the new appointments listed above.

Conferences

12. Collaboration between members of the staff and other research workers in East Africa is being maintained by means of 6-monthly conferences and Fellows' meetings. In July, 1951, a successful conference was held at Astrida by invitation of l'Institut pour la Recherche Scientifique en Afrique Centrale (I.R.S.A.C.). The conference was attended by Professor Louis Van den Berghe (Director of I.R.A.S.C.), Dr. Jaques Maquet, M. L. Delcourt, Dr. J. Hiernaux, Abbe A. Kagamé, M. V. Neessen, M. Corbisier, M. de Clerq, M. Finoulst, Dr. Audrey Richards, Miss J. Fortt, Mr. Donald Leich (W.A.I.S.E.R.), Mr. and Mrs. Fallers, Mr. and

Mrs. P. Gulliver, Mr. and Mrs. A. Harris, Mrs. P. Reining, Mr. and Mrs. J. H. Scherer, Mr. A. W. Southall, Mr. B. Taylor, Mr. G. Wilson, Mr. and Mrs. E. Winter, Mr. and Mrs. J. Goldthorpe, Mr. A. Low, and Mr. H. A. Fosbrooke. A small informal Fellows' meeting was held from 30th December, 1951, to 10th January, 1952. This meeting was an experiment in organizing detailed comparative work on a regional scale and it was attended by all the anthropologists now working among the Lacustrian Bantu (Baganda, Basoga, Batoro, Banyoro, Baha, Bahaya, Bazinza). This small conference of students interested in a particular project proved exceedingly valuable and it was decided that it would be useful to alternate such informal Fellows' meetings with large conferences possibly attended by a wider public. Plans for the publication of a set of essays on political systems in this region were made.

Work in Progress or Completed.

13. *Jinja Survey:* A survey of the European, Indian and African inhabitants of Jinja township has been completed by Mr. and Mrs. Sofer who are now in England writing up their material at the London School of Economics. The survey consisted of a sample survey of the Indian and African communities living in the Jinja township and a census of the European population. After completing this survey Mr. Sofer started work on an intensive survey of race relations in industry of women in three contrasted communities showing different stages of urbanisation of African women. Two articles have been published on this work. ("Some Characteristics of an East African European Population"—British Journal of Sociology, December, 1951; "Population Growth in Jinja"—Uganda Journal, 1952). The report of the survey should be completed this year.

14. *Immigrant Labour in Buganda:* Village surveys in connexion with this project were continued during the year by the Director, Miss Fortt and Mr. A. B. Mukwaya and this material will shortly be ready for publication. Miss Fortt has made a population map showing the distribution of the African population in Buganda based on the 1948 census figures, and has also made maps showing the percentage of immigrants in each sub-country in Buganda. Mr. A. W. Southall and Mr. J. Middleton are completing studies on the Alur and the Lugbara immigrants respectively. It is hoped that the material will be completed for publication in March, 1952.

15. *Beerhall Survey*: At the request of the Kampala Municipality a pilot study of African attitudes towards the municipal beerhall was carried out by the Director and Mr. A. B. Mukwaya in the course of one week. A report was submitted to the Municipality.

16. *Tribal Studies: Alur:* Mr. A. W. Southall completed his field work in June on the Alur and is now in England working up his material at the London School of Economics. *Basoga:* Mr. L. A. Fallers will complete his field work in Busoga by July or August and will then return to Chicago University to work up his material. Mr. Fallers does not at the moment intend to sign a new contract with the Institute. *Bahaya:* Mrs. P. Reining is continuing her field work in Buhaya and will not be due for study leave until March, 1953. *Bazinza:* Mr. J. W. Tyler will finish his field work in August, 1952, and will then return to University College, London. *Baganda:* Mr. A. B. Mukwaya has been working on an intensive study of land tenure among the Baganda. Information as to Ganda clan and local organization has been obtained during the course of the Immigrant Labour village studies in Buganda.

17. *Projects Proposed:* The Institute is proposing to organize a study of the present method of selection and training of African leaders in East Africa. The material from the political field will be provided by the anthropologists, but it is hoped to make studies of the success or failure of Africans in small-scale business in Uganda and Kenya and of leadership in African-organized production, e.g. in the coffee industry in Uganda and parts of Tanganyika. To this end it is hoped that Mr. Wrigley will start a study of the coffee industry in Uganda in the Summer of this year.

18. It is proposed that Mr. S. Morris should make a survey of the Indian community in and around Kampala and should subsequently make comparative studies in one or more other Indian towns.

19. It is proposed that Mr. A. J. Laird should draw up a programme for psychological investigation to be carried on in Uganda after his arrival in March.

20. The Institute has been asked to make a survey of the Kampala township with special reference to the position of African men and women in industry. This project is under discussion.

Publications Contemplated

21. It is hoped that the Jinja survey (see Paragraph 13) and the Immigrant Labour report will be published during the coming year. Mr. A. W. Southall's " Lineage Formation among the Luo " is in the press and he is working on a book on the political system of the Alur. Other publications proposed are " Political Systems of the Lacustrian Bantu," " Comparative Studies of Land Tenure among the Lacustrian Bantu," and " Comparative Studies of Clan Organization in a Group of Selected East African Tribes." Mr. E. M. K. Mulira has ready for publication an article on the tonal classification of Luganda verbs and nouns.

Contacts with other Bodies

22. The Institute has received every assistance from the Uganda Government for the conducting of its research. The Government allowed £606 towards the Immigrant Labour Survey.

23. The Institute was consulted by the Government of Tanganyika on the conducting of a survey of Dar es Salaam and was able to lend the services of Mr. and Mrs. Sofer for a month to give advice. The Government was not, however, able to finance the survey planned.

24. Contact with the College authorities and staff remains close. Reports of the Institute's activities are submitted to the College Council. The Director is a member of the Academic Board of the College and also of its Research Committee. Members of the Social Studies Department of the College were invited to attend the conference at Astrida. It is planned to hold a public conference in co-operation with the College authorities at Christmas 1952.

25. The Institute had a very welcome visit from a delegation of social scientists from American Universities financed by the Carnegie Corporation. The members of the delegation which arrived in March, 1951, were Professor de Kiewiet, Professor R. McLeod, Professor Roland Young and Professor Bennett. Contacts with members of this delegation have been maintained throughout the year. Professor Frank Lorimer of the American University in Washington spent from 24th December, 1951, to 7th January, 1952, making investigations into population problems for UNESCO and was able to attend one session of the Institute conference held at that time.

26. The Director was on leave in the U.K. from August to November, 1951, and attended the Colonial Office Summer School on African Administration at Cambridge during August, a meeting of the Association of Social Anthropologists in September, a meeting of the I.L.O. Committee of Experts on Social Policy in the Non-Metropolitan Countries during November. She also visited the headquarters of UNESCO in Paris and attended a meeting of the Colonial Social Science Research Council.

A. I. RICHARDS

APPENDIX II

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

ANNUAL REPORT

April, 1951, to March, 1952.

The Second year of the Institute's existence has been concerned mainly with Nigeria though a visit of the Director to the Gold Coast in June, 1951, proved fruitful; discussions were held with the Principal of the University College of the Gold Coast and members of the College staff, also with officers of the Administration and of the West African Inter-Territorial Secretariat. It has not yet been possible to open negotiations with Sierra Leone but it is hoped to do this in the near future in co-operation with a member of the Medical Staff of the University College at Ibadan who is himself a Sierra Leonean and has many associations there.

Confronted with so vast a field as British West Africa the planning of research is a very complicated and difficult task. Even if one were able to draw up blueprints for future economic and social investigations, the amount of work that could be done would be restricted by the difficulty of securing competent staff. No attempt, therefore, has been made to cover the whole field.

The two main branches of research with which the Institute is concerned are anthropology and economics and there are differences to be noted in attempting to plan the activities within these two fields. There are a number of anthropologists always at work in West Africa and this is a research outlet which will always be sought after. There are, on the other hand, almost no economists in West Africa except those employed in teaching or administration and one or two short-term visitors, and, in view of the acute shortage of supply at home, the only way of obtaining recruits is by personal persuasion or by arrangement with Universities in the United Kingdom or America to release staff for temporary periods of a year or longer.

One of the tasks of the Institute is to bring isolated research anthropologists into touch with one another. In this connection, I should like to suggest that more attention might be given to the whole question of co-ordination or research in West Africa by the experts at home who are responsible for advising in the selection of scholars and their field of research. Lord Hailey has emphasised this and called attention to the loss of time and money arising from the absence of such co-operation. Meantime, by conferences and the provision of accommodation for short visits, the Institute will make every effort to bring these scholars into touch with each other and to circulate information of work being done from time to time. The Institute is always ready to receive all visiting scholars passing through Lagos and to make arrangements for their arrival and onward journey to their research areas.

The problem of lack of co-ordination does not arise in the economic side of the Institute's work since almost all the schemes at present in hand or projected have the active support of the Government who have themselves put forward a number of them.

1. *Buildings*

The Institute's building programme is completed with the exception of one block of two chalets, four garages and twelve domestic servant's quarters. Work on these has been delayed owing to the difficulties arising from the very rapid expansion of the University College, coupled with an acute labour shortage at Ibadan. Work is now, however, being put in hand and, if there are no more setbacks, will be completed in the current academic year. The accommodation provided, though adequate for the Institute's needs in Nigeria, will not suffice if additional research projects are undertaken on behalf of the Nigeria Produce Marketing Boards (*vide infra*).

2. *Finance*

The Institute's quinquennial Estimates for the period July 1, 1951, to March 31st, 1956, have been approved in full in respect of capital requirements and up to two-thirds of recurrent expenditure. The balance, some £41,000 over a five-year period is being sought on a proportional basis from the West African Governments and the outcome of these negotiations may, it is anticipated, be awaited with confidence.

3. *Staff*

Institute staff in addition to the Director and Administrative Secretary now numbers seven. Additions during the year have been:—

Senior Research Fellows.

History—Dr. K. O. Dike, M.A., History, First Class Honours, Aberdeen, 1947, Ph.D. London, 1950.

Statistician—Miss E. Tanburn, B.A. Honours, Pure and Applied Mathematics, London, 1935. M.Sc. Statistics, 1938. To take up appointment during the Long Vacation, 1952.

Research Fellows.

Anthropology—P. Morton-Williams, B.Sc. Anthropology, 1949, (Horniman Student of the Royal Anthropological Institute, 1949-51).

Economics—Miss Anne Martin, B.A. (Oxon.), P.P.E., First Class Honours, 1949. Research Staff, Cardiff, 1951.

History—P. E. H. Hair, B.A. (Cantab.) History, 1949. Studentship at Nuffield College, Oxford, 1949-51.

The Director is proceeding to the United Kingdom in March to recruit further staff, both for the Institute's own programme and for schemes with which the Institute is associated.

4. *Research*

The Institute staff is engaged in the following research projects.

Enquiry into the Nigerian Monetary and Banking System.

This enquiry has been in operation since January, 1951, by Mr. D. C. Rowan, Research Fellow (Economics). Mr. Rowan is shortly returning to the United Kingdom to write up his material. His enquiry falls into three parts ; first, a description of the present mechanism and the institutions of which it is comprised, second, the analysis of their operation and, third, a discussion of some of the possible policy implications emerging from the two earlier sections. It is hoped that, in addition to the particular relevance to Nigeria, the work will be useful in that it will provide both a description and analysis of the West African variant of the Sterling Exchange Standard, and also a discussion of the monetary and financial needs of a politically and economically dependent territory which is, at the same time, in need of economic development. The method adopted throughout has been that of individual enquiry; it is hoped that a first draft of the work will be ready by September, 1952.

A Comparative Enquiry into Yoruba Social and Economic Organizations.

The project has been in train since June, 1949, the researcher being Mr. P. C. Lloyd, Assistant Research Fellow (Anthropology). During his first tour, ending in October, 1950, Mr. Lloyd resided at Iwo where he obtained a general knowledge of Yoruba ethnography. During his second tour from December, 1950- February, 1952, Mr. Lloyd spent eight months in Ado Ekiti and three months in Shaki. In these two towns he concentrated on a study of the political systems both in the traditional forms which no longer operate and in their present form which represents

an adjustment to suit modern needs of local government. Land tenure and forms of economic organization were also covered. He is at present in Oxford writing up his material.

Trade and Politics in the Niger Delta, 1830-1885.

Dr. K. O. Dike is engaged in revising his thesis for the Ph.D. degree of London University and carrying his original study forward from 1879 to 1885. While in England he explored fully the British sources but there were serious gaps, particularly with regard to the relation of the Delta middlemen to the hinterland tribes. Dr. Dike considers that the history of the Delta during this period is an introduction to the economic history of Eastern Nigeria in particular, and of Nigeria in general. He hopes that his study will be ready for publication in October, 1952.

A Study of the Economics of the Palm Oil Industry in South-East Nigeria.

Miss Martin, Research Fellow (Economics) arrived in Nigeria in December, 1951. After a period of study she assisted Mr. Galletti, Executive Officer in charge of the Economic Survey of the Cocoa Producing Areas of Nigeria, to gain experience and is now exploring the possibilities of a similar study of the economy of the palm-oil industry on more modest lines. Her enquiry may precede a large-scale enquiry to be undertaken by the Palm-Oil Marketing Board.

A Social Study of the Enugu Coalmining Community.

Mr. P. E. H. Hair, Research Fellow (Economics), is preparing an enquiry into the coalmining community of Enugu. He arrived in Nigeria in January, 1952. Mr. Hair spent three years underground during the war and completed a thesis on the Social background of the British Coal Miner while holding a studentship at Nuffield College.

The following projects have been undertaken in association with the Institute, though they are financed from other sources.

A Survey of Ancient Documents in Nigeria.

This project is financed by the Nigerian Government and was commenced a year ago under the direction of Dr. K. O. Dike, who is also engaged on other work (*v. supra*). It is proposed that the survey be completed by January, 1954. In the words of a Nigerian Government Circular letter " the intention is to set up a Public Records Office in Lagos in due course, but, in the meantime, in order to ascertain the nature of available records and the scale of the problem, Dr. K. O. Dike has agreed to undertake a survey of old records." Dr. Dike hopes to produce a short guide to Nigeria Public Records by the end of 1953. One important object already obtained is to put an end to the destruction of valuable historical manuscripts. The headquarters of the survey is in the Institute building at Ibadan.

A Study of the Idoma of Benue Province.

Mr. R. G. Armstrong, a Colonial Research Fellow and American anthropologist with postgraduate training at Oxford, has been engaged for some months in a study of the language and people of Idoma. His headquarters have been at Oturkpo and the Scheme (C.D.W.(R)419) is administered by the Institute. Mr. Armstrong is supervised by Professor E. E. Evans-Pritchard of Oxford University and is at present in the United Kingdom before returning for a final period of approximately six months in the field, to be followed by writing up.

Cinema Audience Research Scheme.

This project is under the control and direction of the Colonial Office and the Institute has seconded Mr. P. Morton-Williams, Research Fellow (Anthropology) to investigate the use of the film as an educational factor with rural audiences in Nigeria. The Technician-in-Charge is Mr. R. Gamble, a film director from the C.F.U., who has with him a mobile cinema and a library of the films which have so far been used for this type of work. The team will stay for periods of approximately a month or six weeks in each of six communities which are thought to represent the diversity of tribal societies in Nigeria. To save time, the audiences

will be chosen from peoples about whom there is alrady some ethnographic information. The investigators arrived in Nigeria in November, 1951, but work has been delayed owing to the non-arrival of the mobile cinema. A first study has, however, been made with equipment kindly lent by the Public Relations Department in the Awori Yoruba village of Egan in Ikeja Division of Lagos Colony. It is planned to proceed as soon as possible to Zaria and the Plateau Province to investigate Hausa and pagan audiences, thence to Bida Emirate to work amongst the Wuju and onwards to Ibo territory.

Post-War Constitutional Development in Nigeria.

This study is being made by Mr. James S. Coleman, a Fulbright Scholar of Harvard University, who has now made his headquarters in the Institute after extensive tours of Nigeria. He will return to the United States in June, 1952. It is hoped in collaboration with the Fulbright authorities that Mr. Coleman will return for a period on the staff of the Institute to complete his studies.

In addition to these projects, the Institute has kept in touch with the Economic Survey of the Cocoa Producing Areas under the direction of Professor Ashby's Committee and with the National Income Survey undertaken by Dr. A. R. Prest and Mr. I. G. Stewart of the Department of Applied Economics of Cambridge University.

5. *The Relation of the Institute to the Nigeria Produce Marketing Boards.*

As a result of discussions between Sir Sydney Phillipson, Chairman of the Marketing Boards, and Professor W. Hamilton Whyte, Director of the West African Institute of Social and Economic Research, definite proposals regarding the function of the Institute in relation to the Marketing Boards have now been put forward.

The Boards are all responsible for research in both the agricultural and the economic field. The view has been taken that the Institute should be available to the Boards in the furtherance of economic research likely to be of practical advantage in the long- or short-term to the work of the Boards and the Regional Production Development Boards, which are largely financed by the Marketing Boards and which constitute an important part of the arrangements which have been built up to promote orderly marketing, stable prices, increased production and economic development of the areas of production.

These services to be rendered by the Institute will, it is anticipated, be of two kinds:—

I. *Current advice on problems referred by the Boards or the Boards' executive.*

Under this head would be included strictly limited investigations of such problems as the practicability of devising a producer price formula which would take account of all the factors.

II. *The organization and general conduct and scientific supervision of large-scale economic surveys.*

For services under I. it is proposed that the Boards should pay to the Institute an annual retaining fee of £5,000 for five years in the first instance, provisionally to cover the cost of a Senior Research Fellow and a Research Fellow together with incidental expenses. No conditions would attach to this grant except that services of the kind described under I. should be given as required. If the cost of providing these services tended to exceed the sum allowed, an adjustment would be possible.

It should be pointed out that this relationship with the Marketing Boards will not prejudice the undertaking of more fundamental research by the Institute but is rather to be regarded as an extension of the Institute's activities.

The Boards concerned would meet the full actual cost of large-scale Economic Surveys, as described under II. These would be separately organized, largely "self-governing" affairs on the lines of the present Economic Survey of the Cocoa Producing Areas. In the same way as this is supervised by Professor Ashby's Committee at Oxford, so would the Institute, possibly with the aid of a specially

constituted Committee, be the focal organizing and supervising body for future economic surveys financed by the Nigeria Produce Marketing Boards. Though the Boards would assist in the administrative and financial field where possible, it would be important that a survey of this type, once established, should be able to run itself under the supervision of the Institute.

An example of the proposals outlined under II. is a projected Agricultural and Economic Survey of the Northern Provinces.

6. *Visitors to the Institute.*

The Institute has been able to assist in various ways a number of researchers in a variety of fields during the past year. This assistance usually takes the form of the offer of accommodation, transport, library facilities and the opportunity to meet other scholars engaged in research in the same field. These visitors include Professor Lorenzo Turner (Fulbright Scholar from Chicago University) studying Nigerian folklore and language, Dr. A. R. Prest and Mr. I. G. Stewart (of Cambridge University), engaged on a Survey of the National Income of Nigeria, Mr. and Mrs. D. J. Stenning (of Cambridge) who are studying the Nomadic Fulani of Northern Nigeria, financed partly by C. D. & W. funds and partly by a Goldsmiths' Scholarship with the assistance of the Nigerian Government; Mr. and Mrs. D. P. L. Dry (of Oxford) engaged on an anthropological study of the Hausa at Soba in Zaria Province; Mr. P. Hackett and Mr. F. D. D. Winston (of the London School of Oriental and African Studies) engaged respectively in studies of the Ibo and the Efik and Ibibio languages; Mr. and Mrs. Simon Ottenberg (of Northwestern University) working on the Ibo; Mr. and Mrs. J. C. Messenger (also of Northwestern) and engaged in a study of the Ibibio at Ikot Ekpene; Mr. Okoi Arikpo (Field Research Assistant, Department of Anthropology, University College, London, 1950-51) who has been studying the Ekoi-speaking peoples of Calabar Province; Mr. C. E. Hopen (holding an International African Institute Research Fellowship) who is to study the Nomadic Fulani in co-operation with Mr. Stenning, and Mr. R. E. Bradbury (holder of University of London Studentship and Emslie Horniman Research Scholarship, 1950-52) who is working in Benin; Dr. and Mrs. W. R. Bascom (of Northwestern University) who were engaged until August, 1951, on a study of the Yoruba in Meko, Oyo and Ilesha, and, finally, Mr. J. H. Price (Lecturer in History of the University College of the Gold Coast) who visited Nigeria to study the working of the New Constitution.

7. *Director*

In addition to the outline of developments in the opening paragraphs of this Report, the Director has also visited the Cameroons and the plantations of the Cameroons Development Corporation. The estates cover a quarter of a million acres and employ nearly 20,000 workers. Urgent problems have arisen in connection with this enormous labour force, which comprise a very mixed community many of whom are recruited from long distances and are cut off from their families and traditional institutions. A recent analysis revealed that some seventy different tribal groups are represented, but the Corporation has little reliable information. It has, therefore, been proposed that the Institute undertake a survey of this labour force, possibly employing an economist and an anthropologist working in co-operation. Plans are at present under discussion, and provided that suitable staff can be obtained the Corporation have promised to assist financially.

The Director has agreed to a request from His Excellency the Governor of Nigeria to act as the Independent Chairman of a Joint Industrial Council in the coal-mining industry at Enugu. He has taken part in preliminary conversations with the parties concerned. In addition to this, he has been asked to accept the Chairmanship of a Committee at present being set up by the Nigerian Government to investigate salary scales of teachers in Nigeria.

8. *Conferences*

The Director joined the Nigerian Delegation to the International West African Conference at Fernando Po in December and read a paper on "Planning Social Research in Nigeria." The Administrative Secretary Mr. D. N. Leich, took the

opportunity of leave in East Africa during the Long Vacation in 1951, to visit the East African Institute of Social Research at Makerere and was able to observe the working of their organization in some detail. The Director, Dr. A. I. Richards, and members of the staff were most helpful and hospitable. He also attended with the East African Institute a Conference at Astrida in Ruanda Urundi in July, 1951, under the auspices of l'Institut pour la Recherche Scientifique en Afrique Centrale (I.R.S.A.C.), reading a paper on the progress of the West African Institute.

The Institute's conference will be held at Ibadan from April 15th to April 19th, 1952. Professor Fortes of Cambridge will be among the distinguished visitors.

Inter-Territorial Development.

The Director, apart from his visit to the Gold Coast in June, 1951, has kept in close touch with the West African Inter-Territorial Secretariat, as has already been indicated. Through its agency, and as the result of a further visit to the Gold Coast, it is hoped to set up an Inter-Territorial Consultative Committee and, possibly, as a first step, to appoint one or two Institute Research Fellows to the Gold Coast to work in co-operation with members of the staff of the University College there. It has already been suggested that Professor Williams of the Department of Economics might act as a representative of the Institute there.

Publications.

The only Institute publication to date has been that of Mr. D. C. Rowan (Research Fellow), entitled " Native Banking Boom in Nigeria " in the October, 1951, edition of " The Banker." Another article pending publication is " Banking Administration in the Gold Coast."

W. HAMILTON-WHYTE.

APPENDIX III

THE RHODES-LIVINGSTONE INSTITUTE

ANNUAL REPORT

April 1951, to March, 1952.

Staff

The year 1951-52 has not seen much progress in the work of the Institute. A serious setback occurred when both Dr. Colson and Dr. Pearsall unfortunately had to resign. Dr. Colson proceeded on leave in August, 1950, and hoped to return to take up a new contract in September, 1951. She spent some months in the United States and then went to Manchester during the early part of 1951 to write up her material on the Plateau Tonga of Northern Rhodesia. She had been elected a Simon Research Fellow at Manchester University for the year 1951. While she was there she was advised by her physician that she should not return to Africa, so that she was obliged to ask the Trustees to release her from taking up her new contract. Dr. Colson's resignation was a severe setback to the work of the Institute. The Trustees and the staff were extremely sorry to lose her able direction of the Institute affairs. She had been Director during the difficult period when the previous research schemes were ending, and while the new schemes were being inaugurated. The vacancy was advertised in November, 1951. In January, 1952, the Trustees appointed Dr. J. C. Mitchell as Director. Dr. Mitchell who has been on the research staff of the Rhodes-Livingstone Institute since 1945, is a graduate in Social Science and honours graduate in Sociology of the University of South Africa, and holds a doctorate in the University of Oxford. He was appointed Senior Research Officer in 1950 to undertake the sociological study of the Copperbelt, and during Dr. Colson's absence on leave had been Research advisor to the Trustees.

Dr. Pearsall arrived in Africa during March, 1951. She visited Dr. Mitchell on the Copperbelt before going out to Nkata Bay. She had not left the District

headquarters at Nkata Bay before she had domestic news which entailed her immediate return to the United States. The vacancy created by her resignation was filled by Mr. J. van Velsen, a graduate of the University of Utrecht and of the University of Oxford. Mr. van Velsen is expected in Africa during March, 1952, and should be in Nyasaland during May or June.

The third resignation was that of the Administrative Secretary, Miss B. Hyam. Miss Hyam was appointed in 1950, shortly before Dr. Colson went on leave. Miss Hyam after only a very short period of induction carried out her duties very efficiently during the time Dr. Colson was away and extended her contract twice in order to continue the administrative side of the work until a replacement could be appointed. The vacancy was advertised in November and numerous applications were received. The Trustees have made their decision and the new Administrative Secretary should take up her duties in the near future.

One other appointment has been made. Mr. W. Watson, D.F.C., who is a graduate of Cambridge University has been appointed to make a study of the Mambwe Lungu people. For some years prior to his appointment Mr. Watson had been making a study of the Lanarkshire miners under Dr. Patterson of the University of Cambridge. Since his appointment in September, 1951, he and Mr. van Velsen have been undergoing some preliminary training in Central African sociology under Professor Gluckman at the University of Manchester. Both officers are expected to sail for Africa in March, 1952, and after a short period of field training in Northern Rhodesia under the Director, should be in their fields in May or June.

There are now four posts on the Institute staff which are not yet filled. These are, first, the vacancy for a Senior Research Officer caused by the appointment of Dr. Mitchell as Director, second, the post of Sociologist who is to assist in the Copperbelt study, third, the post of Lawyer which has been held in abeyance, and fourth, the post of Demographer which has been impossible to fill.

Work in progress

In July, 1951, Mr. I. Cunnison who had been making a study of the peoples of the Luapula Valley, left the field. Mr. Cunnison's contract had in fact ended earlier than this but he decided to use part of his leave period to complete his investigations in that area. He is at present working in Manchester on a major work on that area, the central point of which is to be the chieftaincy. Mr. Cunnison was able during his last year of study, not only to be present at the death and burial of one of the most powerful and picturesque chiefs in Northern Rhodesia, the Mwata Kasembe, but also to be at the installation of his successor.

The Copperbelt study has made good headway. Five junior African research assistants have been appointed and one senior African research assistant, Mr. Godfrey Mukonoweshuro, who is a graduate in History and Social Anthropology in the University of South Africa, has been appointed. There is a further vacancy for a senior African research assistant and one other junior African research assistant. Social surveys of Luanshya including the population of the Roan Antelope Copper Mines African Township and the commercial township, Ndola, have been completed. The survey team is now at work in Kitwe-Nkana. Included in the social survey has been an investigation into cinema attendance amongst Africans at both Luanshya and Ndola, and a survey of reading habits. Dr. Mitchell, with the co-operation of the Northern Rhodesia Police, is conducting an analysis of criminality records amongst Africans, and he is also making a complete analysis of the staff records of African employees of the Nchanga Consolidated Copper Mines, Ltd.

Mr. Turner, who went to the Mwinilunga area in November, 1951, has remained in the same place for over a year. He has been engaged in collecting information on the general social organization of the Lunda people and has also been collecting very valuable material on the ritual and mystical beliefs of the same people. Mr. Turner is due to come out of the field to write his preliminary report.

Mr. Gann arrived in Africa in May and paid a short visit to Northern Rhodesia, during which period he interviewed as many of the old pioneers as he could contact. Since then he has spent most of his time going through the records in the archives in Salisbury. His period of field work is now coming to a close and he is due to return to England in May, 1952, in order to write up his material, which from preliminary accounts, promises to be both interesting and most valuable.

The research work sponsored by the Institute in Southern Rhodesia continued. Dr. Holleman continued work amongst the Shona peoples of Southern Rhodesia. His contract ends in January, 1952. Mr. Hughes, after writing up a preliminary report on the Ndebele under Professor Krige at Natal, has returned to continue his duties.

The past members of the Institute are continuing their writings. Professor Gluckman is at present working on a book on Lozi law. Dr. Colson is working on her Tonga material with particular emphasis on the development of a class of capitalist farmers. Dr. Barnes submitted a thesis to the University of Oxford in October, 1951, and was awarded the degree of Doctor of Philosophy. The body of his thesis, *Politics in a Changing Society: A political history of the Fort Jameson Ngoni,* he has now prepared for publication and is in the hands of the Institute for that purpose. He is now working on a second book dealing with the village structure of the same people. Dr. Mitchell's study of the Yao village and Yao marriage are being revised.

Conferences

With the resignation of Dr. Pearsall and the absence of Dr. Colson it was not considered profitable to hold a conference at the end of 1951. It is hoped, however, than one may be held in May, 1952.

Publications

The major event for the Institute in 1951-52, is the publication of the book *Seven Tribes of British Central Africa,* which appeared in the middle of 1951. Thus far the reviews have continued to be good and sales are encouraging. This is the first major publication by the Institute and augers well for the future. Dr. Barnes's study of Ngoni Marriage appeared during this year as the Rhodes-Livingstone Paper No. 20. Mr. Cunnison's paper on the history of the Luapula Valley has not yet appeared. Two journals were published.

Buildings

At last the buildings for the Institute headquarters in Lusaka have commenced. Tenders were put out during the middle months of 1951, and by January, 1952, the site was being cleared and the foundations marked out. The contract period ends in June, 1952, so that it is reasonable to expect that by that time the Institute will be permanently housed at Lusaka.

The prospect for 1952, therefore, is hopeful and the Institute looks forward to a more settled and productive year.

J. C. MITCHELL.

APPENDIX IV

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

ANNUAL REPORT

April 1, 1951—March 31, 1952.

GENERAL

Director - - - -	H. D. Huggins.
Junior Research Fellow - -	L. Braithwaite.
" " " - -	G. E. Cumper.
" " " - -	N. M. Siffleet.
" " " - -	K. H. Straw.

The Institute of Social and Economic Research has been set up to undertake research in the social sciences, primarily in those areas which have first claim upon the University College of the West Indies—British Honduras, Jamaica, the Leeward Islands, the Windward Islands, Barbados, Trinidad and British Guiana. While the headquarters is in Jamaica with the University College, members of the research staff are carrying out research projects in the several units. The original and main purpose of the Institute, as conceived by those who recommended its establishment, was to provide material as a basis for teaching the social sciences in the area. It is also hoped, by increasing of the stock of knowledge, to facilitate the discussion and administration of social and economic policy.

The first appointments to the research staff were made in August, 1949. In the history of an organization like the Institute it is a particularly difficult period when the field work, having been planned and taken forward, the organization with its supporters looks forward anxiously and hopefully for results. It is at this stage that the Institute now is.

The following are projects which were taken further forward and which were sponsored by the Institute:

Labour Productivity—Mr. George Cumper, economist, was completing a study relating to labour productivity in special reference to the sugar industry in Jamaica. Main effort had been directed to a field of study in connection with field and factory operations on sugar producing units in different parts of Jamaica. One of the sugar estates selected was interesting in that it drew its labour force in substantial numbers from workers with both urban and rural backgrounds.

Social Structure—Mr. Lloyd Braithwaite, sociologist, completed his field work on a study relating to social structure, in a community predominantly West Indian, in Trinidad and has arrived at the drafting stage of his findings. He began field work on a second community, mainly East Indian, which was felt to be complementary to the first. The ethnic groups differed markedly in culture but the interactions had significance on the social and economic life of the community. It was hoped that Mr. Braithwaite, himself a Trinidadian, would be in a position to evaluate the factors and their inter-relationships with intimacy. It is planned that he should return to Jamaica in the middle of 1952, to continue his writing-up.

National Income Estimates—Miss Nora Siffleet, economist, spent part of the year in the Leeward Islands and then returned finally to the Institute to continue her preparation of estimates of Antigua, St. Kitts-Nevis, Grenada, St. Vincent, Dominica, St. Lucia and Barbados. During the past twelve months the work of estimating the national incomes of certain islands in the Eastern Carribbean entered upon its last stages. With most of the necessary data in hand, it remained only to fill in some of the gaps and to prepare the final report. In the summer of 1951,

some time was spent in Antigua and St. Kitts obtaining additional material. A survey of minor industries and distributive trades in Antigua was aundertaken to supplement the material already available about other sectors of the economy. In St. Kitts-Nevis a survey of the exports of agricultural produce from Nevis to St. Kitts was undertaken with a view to obtaining data about the production of food crops in Nevis and ascertaining the significance of the contribution of Nevis to the economy of the Presidency. The Report on Unemployment in Antigua was drafted and sent to press. The final report will be published shortly. The summer of 1952, will see the completion of this first essay at national income estimates in this territory. It is hoped that the estimates for Barbados and Antigua will be reasonably accurate and that the estimates for the other places will be as good as the inadequate data available allows.

Consumption Patterns—Mr. Kenneth Straw, economist, was endeavouring to determine the trend in consumption patterns in Barbados. If it was found that real income was rising—and the national income estimates under preparation would give an indication—the direction of consumption trends could have a good deal of relevance to development. The study was conceived as involving investigations of past trends in the growth of demand for different items of consumption and disclosing information bearing on the relevant marginal propensities to consume, or Engel lines. The first part of the study entailed taking a sample of households and by means of a questionnaire and interviews obtaining information on income expenditure. Ideally, it would have been desirable to carry out the survey by taking a random sample of households over the whole island. Owing to limited resources this was not found to be possible and it was decided to select two or three specific areas for study. The questionnaire was so planned that it served the purposes of the study and also provided the Government with the data necessary to obtain a pattern of consumption from which the rates for a cost of living index could be calculated. Through the kind collaboration of the Government, teachers were encouraged to act as enumerators and the collaboration reported was most encouraging. The first part of the field work was done in the off-season of 1951, when the sugar estates were not grinding and employment was at a low level. The second part of the study was begun in March, 1952, to give a picture of consumption patterns when seasonal employment was at its highest. In the first field study about 730 questionnaires were completed out of the original 800. The highest percentage of refusals was obtained in Bridgetown, the main urban centre of the island.

Industrial Relations—Mrs. Ella Campbell was continuing her work on the project —"Experiences of management in the adaptation and training of Jamaican industrial workers." The subject of training methods and techniques seemed a well defined field and lent itself readily to a limited study. The study was based on the experience of managements in the adaptation and training of workers for industrial employment with regard to the relative effectiveness of the various training methods. The co-operation of industrialists and Trade Unions was enlisted and interviews with various members of management were followed up by observations in the factory and conversations with instructors and workers. The study was confined to light industries with a majority of semi-skilled and unskilled occupations, employing male and female workers as it was expected that the training methods would be more varied and flexible in such establishments. Geographically, the study was confined to the area of Kingston and its suburbs, the industrial centre of the island. The project was divided into two parts: first, studies in factories established for several years and considered old industries. Secondly, studies in new industrial establishments. From May, to December, 1951, the actual field work was carried on and 24 factories covered. The material collected was being analysed and Mrs. Campbell was engaged in the writing up of her project.

Development in Jamaica—During the year in such time as was available for personal participation in research, the Director worked on a project relating to the economic analysis of the factors relevant to development in Jamaica. As in many other underdeveloped territories the population question, while urging a high agricultural production, was itself a factor in inducing low productivity. Agricultural

development and other development providing new avenues of employment were therefore complementary. The study reached the writing-up stage.

The following were studies, whose direction was on quite an independent basis, but with which the Institute was indirectly associated:

A Subsistence Economy—Raymond T. Smith, social anthropologist, was awarded a colonial studentship to undertake a study of the social structure of villages on the coastlands of British Guiana. The project is being financed from Colonial Development and Welfare Research funds, and Mr. Smith forwards regular reports on the progress of the investigation to his Director of Studies, Professor M. Fortes of Cambridge University.

Amer-Indians—Miss Audrey Butt, social anthropologist, was awarded a special grant to make a study of the Arecuna and Akowoio peoples under the general direction of Professor Evans-Pritchard of Oxford. With the expansion of activity in the hinterland of British Guiana there was a growing disruption of tribal life and a study at this stage should provide information which later would probably be unavailable.

Juvenile Delinquency—Mr. Harland Doughty, sociologist, visited Jamaica from June, to September, 1951, for a study of juvenile delinquency. This work was undertaken under the general direction of Professor Elizabeth Hoyt of the Iowa State College, Amos, Iowa. Mr. Doughty did much of his work at the Industrial School and the Probation Office, where by courtesy the records were made available.

MISCELLANEOUS

Library: The social science collection has grown during the past year and its use as a reference library for the research staff has become increasingly evident. The major activities during the year related to the indexing of material received and included attention to pamphlets and periodicals apart from books. This has made the collection all the more serviceable and, while the work involved has been demanding, it is felt to be a contribution to research effort that is well worth while. In order to ensure that the collection was completely integrated with the main library, close collaboration had been the aim of the Institute. On his part, the Librarian of the University College, had given the type of detailed instruction in order to make possible the use of the Library of Congress index system.

Director: During the year the Director visited the Eastern Carribean for conferences with the research staff. He also attended a conference on industrialisation held in Puerto Rico under the auspices of the Carribean Commission. At the request of the Government, the Director has been appointed a member of an Advisory Committee on the cattle industry beef prices in Jamaica.

Hurricane: A hurricane struck Jamaica on the night of August 17. The wooden hut which then housed the Institute had much of its roof removed. The damage to equipment generally and to publications, in particular, was considerable. Some of the loss to publications was made up by gifts from those who had previously visited the Institute. Those who had contributed helpfully included: Mr. Francis Scheetz, Dr. Leonard Broom, Dr. Joseph Moore. The permanent building of the Institute was occupied on August 21, 1951.

Advisory Board: The Advisory Board meeting was held on the 17th of January. Present were: The Director (Chairman), Sir Raymond Priestley, the Hon. Garnet Gordon, Hon. Sydney Christian, Hon. E. L. M. Kirkwood, Miss Ibberson and by special request Dr. Simon Rottenberg. Excuses were offered for: Professor C. J. Beasley and Hon. W. H. Courtenay.

Staff Flats: The flats for members of staff were under construction and it was hoped that they would be completed in the next four to five months. There would be four flats, two larger and two smaller to accommodate four families.

Visitors: The Institute was honoured by a visit from H.R.H. Princess Alice who commented favourably on the simple functional style of the Institute's building and its pleasant surroundings. Among the other visitors who came and contributed stimulatingly might be mentioned: Dr. Simon Rottenberg, Mr. W. M. Woodhouse, Mr. J. M. Fraser (Singapore), Mr. Alan Pifer, Miss D. Ibberson, Mr. W. M. Chinn, Mr. H. Solow, Dr. A. B. Lewis.

H. DUDLEY HUGGINS.

APPENDIX V

Publications by Research Workers Assisted by the Council

African Studies Branch	Bibliography of African Land Tenure.	Colonial 258, H.M.S.O.	1951
Anderson, J. N. D.	Recent Developments in Shari'a Law, Parts I—IV.	Muslim World.	Oct., 1950—July, 1951
	Islamic Law in African Colonies.	Corona, Vol. III, No. 7.	1951
Ady, P. ... ... (with M. Fortes and R. W. Steel)	Ashanti Survey, 1945-46; An Experiment in Social Research.	Geographical Journal, Vol. CX., Nos. 4—6.	1947 (published 1948)
Allott, A. N.	The Extent of the Operation of Native Customary Law: Applicability and Repugnancy.	Journal of African Administration, Vol. 2, No. 3.	1950
Barnes, J. A. ... ... (with J. C. Mitchell)	The Lamba Village: A Report of a Social Survey.	Communications from the School of African Studies, University of Capetown (New Series, 24).	1950
Barnes, J. A. (with M. Gluckman and J. C. Mitchell)	The Village Headman in British Central Africa.	Africa, Vol. XIX.	1949
Barnes, J. A.	The Collection of Genealogies.	Human Problems in British Central Africa, No. V.	1947
	Some Aspects of Political Development among the Fort Jameson Ngoni.	African Studies, Vol. VII	1948
	Material Culture of the Fort Jameson Ngoni.	Rhodes-Livingstone Museum Papers (New Series) No. 1.	1949
	The Social Organization of the Fort Jameson Ngoni.	In *Seven Tribes of British Central Africa,* (E. Colson and M. Gluckman, Eds.) O.U.P.	1951
	Marriage in a Changing Society.	Rhodes-Livingstone Paper No. 20, O.U.P.	1951

Barnes, J. A., contd.	History in a Changing Society.	Human Problems in British Central Africa, No. XI.	1951
	Measures of Divorce Frequency in Simple Society.	Journal of the Royal Anthropological Institute, Vol. LXXIX, 1 and 2.	1951
Basset, André, ...	Part I of Handbook of African Languages: La Langue Berbère.	O.U.P.	1952
Batson, Edward	Report on prospects for a Social Survey of Zanzibar.	Government Printer, Zanzibar.	1948
Berry, J.	The Pronunciation of Ga.	Heffer.	1951
Bedell, B. J.	Determination of the Optimum Number of Items to retain in a Test measuring a single ability.	Psychometrika, Vol. 14, No. 4.	1950
Bryan, M. A.	Notes on the Distribution of the Semitic and Cushitic Languages of Africa.	O.U.P.	1947
	Distribution of the Nilotic and Nilo-Hamitic Languages of Africa.	O.U.P.	1948
Butt, Audrey J.	The Nilotic Peoples of East Africa.	*Ethnographic Survey of Africa,* International African Institute.	1952 (in the press)
Chelliah, D. D.	A Short History of the Educational Policy of the Straits Settlements.	Government Press, Kuala Lumpur.	1948
Collins, G. R.	Movements of Population from Rural to Urban Areas in Sierra Leone, with special reference to Economic Aspects and to the Colony Rural Areas.	Working Paper for the 27th Study Session of the International Institute of Differing Civilizations (I.N.C.I.D.I.) Florence.	June, 1952
Collins, G. R. ... ... (with E. M. Richardson)	The Rural Creoles of Sierra Leone.	West Africa.	March-April, 1952
Colson, E.	Rain Shrines of the Plateau Tonga.	Africa, Vol. VIII.	1948
	Modern Political Organization of the Plateau Tonga.	African Studies, Vol. VII	1948
	Life among the Cattle-owning Plateau Tonga.	Rhodes-Livingstone Museum Papers (New Series) No. 6.	1949

Colson, E., contd.	Possible Repercussions of the Right to make Wills upon the Plateau Tonga.	Journal of African Administration, Vol. 2, No. 1.	1950
	A Note on Tonga and Ndebele.	Northern Rhodesian Journal, No. 2.	1950
	Social Organizaton of the Plateau Tonga.	In *Seven Tribes of British Central Africa,* (E. Colson and M. Gluckman, Eds.) O.U.P.	1951
	The Rôle of Cattle among the Plateau Tonga.	Human Problems in British Central Africa, No. XI.	1951
	Village Stability among the Plateau Tonga.	Human Problems in British Central Africa, No. XII.	1952 (in the press)
Cunnison, I. G.	Kinship and Local Organization on the Luapula.	Communications of the Rhodes-Livingstone Institute, No. V.	1950
	A Watchtower Assembly in Central Africa.	International Review of Missions.	Oct., 1951
	The Death and Funeral of Kazembe XV.	Northern Rhodesian Journal, No. 4.	Dec., 1951
	History on the Luapala.	Rhodes-Livingstone Papers No. 21.	1952 (in the press)
Doke, C. M.	Bantu: Modern Grammatical, Phonetical and Lexicographical Studies.	In *Handbook of African Languages.* Percy Lund Humphries & Co.	1945
Epstein, A. L.	Urban Native Courts in the Northern Rhodesia Copperbelt.	Journal of African Administration, Vol. 3, No. 3.	1951
	Some Aspects of the Conflict of Law and Urban Native Courts.	Human Problems in British Central Africa, No. XII.	1952 (in the press)
Firth, Raymond	Social Problems and Research in British West Africa.	Africa, Vol. VII.	1947

Firth, Raymond, contd.	Social Science Research in Malaya.	Government Printer, Singapore.	1948
Forde, Daryll	The Yoruba Speaking Peoples of South-Western Nigeria.	*Ethnographic Survey of Africa,* West Africa, Part 4, International African Institute.	1951
Forde, Daryll and Jones, G. I.	Th Ibo and Ibibio-Speaking Peoples of South-Eastern Nigeria.	*Ethnographic Survey of Africa,* West Africa, Part 3, International African Institute.	1950
Fortes, M.	The Ashanti Social Survey; Preliminary Report.	Human Problems in British Central Africa, No. VI.	1948
	Kinship and Marriage among the Ashanti.	In *African Systems of Kinship and Marriage* (Eds. A. R. Radcliffe-Brown and C. D. Forde), O.U.P for International African Institute.	1950
Fortes, M. ... ... (with P. Ady and R. W. Steel)	Ashanti Survey, 1945-6. An Experiment in Social Research.	Geographical Journal, Vol. CX, Nos. 4—6.	1947 (published 1948)
Freedman, M.	Colonial Law and Chinese Society.	Journal of the Royal Anthropological Institute, Vol. 80, 1950.	1952
Gamble, D. P.	Notes on Mandinka.	Government Printer, Bathhurst, Gambia.	1949
	Infant Mortality Rates in Rural Areas in the Gambia Protectorate.	Journal of Tropical Medicine and Hygiene.	1952 (in the press)
Gluckman, M.	The Lozi of Barotseland in North-Western Rhodesia.	In *Seven Tribes of British Central Africa* (Eds. E. Colson and M. Gluckman) O.U.P. for Rhodes-Livingstone Institute.	1951

Gluckman, M., contd.	Kinship and Marriage among the Lozi of North-Western Rhodesia and the Zulu of Natal.	In *African Systems of Kinship and Marriage* (Eds. A. R. Radcliffe-Brown and C. D. Forde) O.U.P. for International African Institute.	1950
	Malinowski's Sociological Theories.	Rhodes-Livingstone Paper No. 16.	1949
	The Rôle of the Sexes in Circumcision Ceremonies among the Wiko of North-Western Rhodesia.	In *Social Structure: Essays Presented to A. R. Radcliffe-Brown.* Oxford: Clarendon Press.	1949
Gulliver, Philip H.	A Preliminary Survey of the Turkana: A Report compiled for the Government of Kenya.	Communications from the School of African Studies, (New Series) No. 26, University of Capetown.	1951
	The Name Lango as a Title for the Nilo-Hamites.	Uganda Journal: Vol. 15, No. 1.	1951
	Bell-Oxen and Ox-Names among the Jie.	Uganda Journal, Vol. 16, No. 1.	1952
	The Karamojong Cluster.	Africa: Vol. XXII.	1952
Guthrie, M.	Classification of the Bantu Languages.	In *Handbook of African Languages.* O.U.P.	1948
Holleman, J. F.	The Pattern of Hera Kinship.	Rhodes-Livingstone Papers, No. 17.	1949
	Some Shona Speaking Tribes.	In *Seven Tribes of British Central Africa* (Eds. E. Colson and M. Gluckman), O.U.P.	1951
	An Anthropological Approach to Bantu Law with special reference to Shona Law.	Rhodes-Livingstone Journal No. X.	1951
	Hera Court Procedure.	NADA.	1951
	Shona Customary Law.	O.U.P.	1952

Holleman, J. F., contd.	Accommodating the Spirit amongst some N.E. Shona Tribes.	Rhodes-Livingstone Papers.	1952 (in the press)
Huntingford, G. W. B.	Nandi Work and Culture.	Colonial Research Studies No. 4, H.M.S.O.	1950 (appeared in 1951)
Ingrams, Doreen	A Survey of the Social and Economic Conditions in the Aden Protectorate.	Government Printer, Aden.	1949
Kaberry, Phyllis M.	Land Tenure among the Nsaw of the British Cameroons.	Africa: Vol. XX.	Oct., 1950
	Nsaw History and Social Categories.	Africa: Vol. XXII.	Jan., 1952
	Women of the Grassfields: The Rôle of Women in the Economy of Bamenda, with particular reference to Nsaw.	Colonial Research Publications. H.M.S.O.	1952 (in the press)
Kerr, Madeline	Personality and Conflict in Jamaica.	University of Liverpool Press.	1952 (in the press)
Kuczynski, R. R.	Demographic Survey of the Colonial Empire, Vol. I, West Africa.	Oxford University Press (for R.I.I.A.)	1948
	Vol. II, South Africa, High Commission Territories, East Africa, Mauritius, Seychelles.	Oxford University Press (for R.I.I.A.)	1949
Kuper, Hilda	The Swazi.	*Ethnographic Survey of Africa.*	1952 (in the press)
Leach, E. R.	Some Features of Social Structure among Sarawak Pagans. (Summary of a Communication to the Royal Anthropological Institute).	Man, 103.	1948
	Social Science Research in Sarawak.	Colonial Research Studies No. 1, H.M.S.O.	1950
	A Kajaman Tomb Post from the Belega Area of Sarawak.	Man, 218.	1950

Leach, E. R., contd.	A Melanau (Sarawak) Twine making Device.	Journal of the Royal Anthropological Institute, Vol. LXX.X.	1951
Little, K. L.	The Mende Rice Farm and its Cost.	Zaïre.	March-April, 1951
	The Mende of Sierra Leone.	Routledge and Kegan Paul.	1952
	Mende Political Institutions in Transition.	Africa, Vol. XVII.	1947
	Changing Position of Women in the Sierra Leone Protectorate.	Africa, Vol. XVIII.	1948
Lloyd, P. C.	Some Comments on the Elections in Nigeria.	Journal of African Administration, Vol. 4, No. 3.	1952 (in the press)
Mair, Lucy	A Yao Girl's Initiation.	Man, 98.	1951
	Native Administration in Central Nyasaland.	Colonial Research Studies, No. 5, H.M.S.O.	1952
Manoukian, Madeline	Akan and Ga-Adangme Peoples of the Gold Coast.	*Ethnographic Survey of Africa*, West Africa, Part 1, O.U.P.	1950
	Tribes of the Northern Territories of the Gold Coast.	*Ethnographic Survey of Africa*, West Africa, Part 5, O.U.P.	1952
	The Ewe of Togoland.	*Ethnographic Survey of Africa.* International African Institute.	1952 (in the press)
Marwick, M. G.	A Study of Social Attitudes.	Human Problems in British Central Africa, No. V.	47
	African Witchcraft and Anxiety Load.	Theoria, No. 2.	1948
	Another Modern Anti-Witchcraft Move-	Africa, Vol. XX.	1950

Mayer, Philip	The Lineage Principle in Gusü Society.	I.A.I. Memoranda No. XXIV.	1949
	Gusii Bridewealth Law and Custom.	Rhodes-Livingstone Papers, No. 18.	1950
	Privileged Obstruction of Marriage Rites among the Gusii.	Africa, Vol. XX.	1950
	Two Studies in Applied Anthropology in Kenya.	Colonial Research Studies, No. 3, H.M.S.O.	1951
	The Joking of " Pals " in Gusii Age-Sets.	African Studies, Vol. X.	1951
McCulloch, Merran	The Peoples of Sierra Leone Proctectorate.	*Ethnographic Survey of Africa,* West Africa, Part 2. International African Institute.	1950
	The Southern Lunda and Related Peoples (Northern Rhodesia, Angola, Belgian Congo).	*Ethnographic Survey of Africa,* West Central Africa, Part 1, International African Institute.	1951
Meyerowitz, Eva L. R.	The Sacred State of the Akan.	Faber & Faber.	1951
	Concepts of the Soul among the Akan of the Gold Coast.	Africa, Vol. XXI.	1951
	Akan Traditions of Origin.	Faber & Faber.	1952
Milner, G. B.	A Study of Two Fijian Texts.	Bulletin of the School of Oriental and African Studies.	June, 1952
Mitchell, J. C. ... ... (with M. Gluckman and J. A. Barnes)	The Village Headman in British Central Africa.	Africa, Vol. XIX.	1949
Mitchell; J. C.	An Estimate of Fertility in some Yao Hamlets in Liwonde District, Southern Nyasaland.	Africa, Vol. XIX.	1949
	The Collection and Treatment of Family Budgets in Primitive Communities as a field problem.	Human Problems in British Central Africa, No. VIII.	1949
	The Political Organization of the Yao of Southern Nyasaland.	African Studies, No. VIII.	1949
	Preliminary Notes on Land Tenure and Agriculture among the Machinga Yao.	Human Problems in British Central Africa, No. X.	1950

Mitchell, J. C. ... ... (with J. A. Barnes)	The Lamba Village: A Report of a Social Survey.	Communications from The School of African Studies, Capetown. (New Series) No. 24.	1950
Mitchell, J. C.	An Outline of the Social Structure of Malemia Area.	Nyasaland Journal, Vol. IV, No. 2.	1951
	The Yao of Southern Nyasaland.	In *Seven Tribes of British Central Africa* (Eds. E. Colson and M. Gluckman), O.U.P.	1951
	A Note on the Urbanisation of Africans on the Copperbelt.	Human Problems in British Central Africa No. XII.	1952
(with other team members)	Reading Habits in a Part of the Mushri Reserve.	Human Problems in British Central Africa, No. IX.	1951
Northcott, C. H.	African Labour Efficiency Survey.	(Ed. C. H. Northcott with P. W. Gross, A. L. Crampton-Chalk, H. C. Trowell, D. Harvey, J. H. Henry and M. W. Grant). Colonial Research Publications No. 3, H.M.S.O.	1949
Parker, Mary	Municipal Government and the Growth of African Political Institutions in Urban Areas of Kenya.	Zaire.	1949
	Race Relations and Political Development in Kenya.	African Affairs, Vol. 50, Nos. 198 and 199.	1951
	Social and Political Development in Kenya Urban Society.	Problèms d'Afrique Centrale, No. 5.	1952
Peggs, A. Deans	Note on a "New" Non-Verbal Intelligence Test Item.	British Journal of Psychology (General Section), Vol. XLII, Pts. 1 and 2.	1951
	Analysis of Variance with Unequal Numbers.	British Journal of Psychology (Statistical Section), Vol. IV. Part 2.	1951
Peristiany, J. G.	The Age-Set System of the Pastoral Pokot.	Africa, Vol. XXI.	1951

Peristiany, J. G., contd.	Law and Sanctions.	Proceedings of the Third International Congress on Comparative Law, Rome, 1949.	1952 (in the press)
Prins, A. J. H.	An Outline of the Descent System of the Teita.	Africa, Vol. XX.	1950
	The Coastal Tribes of the North-Eastern Bantu: Pokomo, Nyika and Teita.	*Ethnographic Survey of Africa,* East Central Africa, Part 3. International African Institute.	1952
Richardson, E. M. and Collins, C. R. ...	The Rural Creoles of Sierra Leone.	West Africa.	March-April, 1952
Schacht, J.	L'Islam en Nigerie. (Lecture given at the University of Algiers).	Bulletin des Etudes Arabes, Algiers. Vol. X, No. 48.	1950
	La Justice en Nigerie du Nord et le Droit Musulman.	Revue Algerienne de Legislation et de Jurisprudence, Algiers. Vol. 67, No. 2.	1951
Schapera, I.	Some Problems of Anthropological Research in Kenya Colony.	International African Institute Memoranda No. XXII.	1949
Serjeant, R. B.	"Cant" in Contemporary South-Arabic Dialect.	Transactions of the Philological Society.	1948
	Two Tribal Law Cases (Wahidi Sultanate, S. W. Arabia).	Journal of the Royal Asiatic Society.	1951
Sheddick, V. G.	The Morphology of Residential Associations as found among the Khwa Khwa of Basutoland.	University of Capetown: Communications from the School of African Studies (New Series) No. 19.	1948

Slaski, J. (see Whiteley, W.)	Bemba and Related Peoples of Northern Rhodesia (including Ambo) and Peoples of the Lower Luapula Valley.	*Ethnographic Survey of Africa,* East Central Africa, Part 2. International African Institute.	1951
Sofer, C. and R.	Some Characteristics of an East African European Population.	British Journal of Sociology, Vol. 11, No. 4.	1951
	Population Growth in Jinja.	Uganda Journal.	1952 (in the press)
Southall, A. W.	An Alur Legend of Baker and Kabarega.	Uganda Journal. Vol. 15, No. 2.	1951
	Lineage Formation among the Luo.	International African Institute Memorandum No. XXVI.	1952 (in the press)
Stanner, W. E. H.	Observations on Colonial Planning.	International Affairs. Vol. 25.	1949
Tew, Mary, ...	Peoples of the Lake Nyasa Region.	*Ethnographic Survey of Africa,* East Central Africa, Part 1, O.U.P.	1950
Tooth, Geoffrey, Dr.	Studies in Mental Illness in the Gold Coast.	Colonial Research Publications No. 6, H.M.S.O.	1950
Westermann, D.	West African Languages.	In *Handbook of African Languages.*	1952 (in the press)
Whiteley, W. and Slaski, J.	Bemba and Related Peoples of Northern Rhodesia (including Ambo) and Peoples of the Lower Luapula Valley.	*Ethnographic Survey Series,* East Central Africa, Part 2, International African Institute.	1951
Wolfson, Freda	Historical Records in the Gold Coast.	Bulletin of the Institute of Historical Research. Vol. XXIV.	1951

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

Baldwin, K. D. S.—" Rural Economy of the Krobos " (1950).

Elliott, Alan, J. A.—"Chinese Spirit-Medium Cults in Singapore " (1952).

Gamble, D. P.—" Contributions to a Socio-Economic Survey of the Gambia " (1949); " Mandinka Grammar and Dictionary " (1949).

Lewis, M. B.—" The Teaching of Malay in English Schools in Malaya ", (1948).

Matson, I. C.—" Report on Land Disputes in the Adansi Division, Obuasi District, Ashanti " (1947).

Middleton, J. F. M.—" Labour Migration and the Lugbara " (1952).

Parker, Mary—" Political and Social Aspects of the Development of Municipal Government in Kenya, with special reference to Nairobi " (1949).

Schacht, J.—" Report on the position of Muhammadan Law in Northern Nigeria " (1950).

Smithies, F.—" Science Teaching in Secondary Schools in West Africa " (1950).

Stanner, W. E. H.—" Social Research Needs in Uganda and Tanganyika " (1949).

Tooth, Geoffrey—" Survey of Juvenile Delinquency in the Gold Coast " (1946); " On the Use of Psychological Tests for the Selection of Candidates for Technical Training in Nigeria " (1950).

Wells, A. F. and D.—" Friendly Societies in the West Indies " (1949).

Wilson, G. M.—" Clan and Political Organization among the Barabaig " (1952).

Colonial Medical Research Committee Seventh Annual Report (1951-1952)

Medical Research Council,
38, Old Queen Street,
S.W.1.
3rd July, 1952.

SIR,

On behalf of the Colonial Medical Research Committee, I have the honour to transmit to you the Seventh Annual Report of the Committee, covering the period 1st April, 1951, to 31st March, 1952.

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

Membership

SIR HAROLD HIMSWORTH, K.C.B., M.D., F.R.C.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., M.R.C.P., Professor of Pharmacology, University of Birmingham.

DR. P. C. C. GARNHAM, M.D., D.P.H., Reader in Medical Parasitology, 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, 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.

DR. E. D. PRIDIE, 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, 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.

Dr. E. D. Pridie, C.M.G., D.S.O., O.B.E., M.B., B.S.

Colonel H. E. Shortt, M.D., Ch.B., F.R.S., Professor of Medical Protozoology, University of London.

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. E. D. Pridie, 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, 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, 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.

Dr. E. D. Pridie, 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
SEVENTH ANNUAL REPORT

CONTENTS

COLONIAL MEDICAL RESEARCH COMMITTEE

SEVENTH ANNUAL REPORT

GENERAL

1. Twelve meetings of the Committee and its Sub-Committees were held during the year.

2. Sir Alan Drury retired from the Committee. The counsel of this distinguished scientist will be much missed. The membership of the Committee was enlarged by the addition of Sir Wilson Jameson, Major-General Sir Gordon Covell, Professor H. M. Gordon, Professor A. C. Frazer, Professor G. Macdonald, and Dr. P. C. C. Garnham. Sir Neil Hamilton Fairley retired from the Chairmanship of the Malaria Sub-Committee and Helminthiasis Sub-Committee; the new Chairmen are Brigadier J. S. K. Boyd and Professor R. M. Gordon respectively. The Personnel Sub-Committee was revived; Professor G. Macdonald succeeded Sir Alan Drury as its Chairman.

It is gratifying to record the conferment of the honour of Knight Commander of the Bath on the Chairman of the Committee, Dr. H. P. Himsworth.

3. Following the procedure adopted last year, this Report includes summaries of investigations in the medical field made by research units or organizations that are wholly supported by the Governments of British Colonial Territories or Mandated Territories. For continuity of context some are placed immediately after similar reports from units that are the scientific responsibility of the Committee.

COLONIAL RESEARCH SERVICE

4. The Personnel Sub-Committee made general recommendations from time to time concerning appointments to this Service. It also interviewed new applicants for the Service, and 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

5. All the main research schemes that were in progress during the previous year have been continued. Although recruitment still lags behind requirements, it has been possible to fill thirteen vacancies on the various establishments, two of them from former holders of Colonial Medical Research Studentships on completion of their specialized training. Two Students continue their training for a second year, one in virus investigation under Professor Sir Macfarlane Burnet, F.R.S., in Melbourne, the other in helminthology under Professor J. J. C. Buckley, D.Sc., at the London School of Hygiene and Tropical Medicine. Another Student, newly appointed, is also studying under Professor Buckley.

Development of Research Schemes.

6. The Research Schemes under the scientific supervision of the Committee during the year were twenty in number, staffed with forty-two senior graduates in medicine or its cognate sciences and a large ancillary staff of European and locally trained technicians. One malaria research scheme, in Jamaica, was concluded; and established with similar objectives in the Gold Coast. Another malaria research scheme in Nigeria came under the aegis of the Government of that territory. A small grant was made towards the cost of a new research project, an investigation of goitre by Dr. Dagmar Wilson in Nigeria.

Finance

7. In the light of rising costs and a limited budget, the Committee kept under constant review the progress of the various research projects in order to maintain a correct perspective between existing investigations and the competing claims of new proposals. The relevant Sub-Committees made appropriate recommendations, and a balanced programme of research was drawn up which permitted a certain reserve of funds to be held against the possible need to initiate urgent new schemes.

Overseas Visits

8. Personal contact of members of the Committee and Sub-Committees with medical research units overseas has been increasingly maintained. Sir Harold Himsworth and Professor B. G. Maegraith visited most of those in West Africa; and represented the Committee at the inaugural meeting of the West African Standing Advisory Committee for Medical Research, held at Ibadan; Professor R. M. Gordon spent a considerable period of time with the Loiasis Research Unit at Kumba in the British Mandated Cameroons; and Professor G. Macdonald visited the Gold Coast and Nigeria. Professor B. S. Platt and Dr. F. Hawking participated for some months in the work of the Field Research Station at Fajara in the Gambia; this territory was also visited by Brigadier J. S. K. Boyd, Major-General Sir John Taylor, and Dr. A. Landsborough Thomson, Second Secretary of the Medical Research Council, who assessed the need for an extension of medical research there. The progress of the various medical research units in East Africa was studied at first-hand by Professor P. A. Buxton and Professor A. C. Frazer, who also represented the Committee at the inaugural meeting of the East African Standing Advisory Committee for Medical Research, held at Nairobi. Dr. E. D. Pridie, in the course of a tour of the Medical Services in the Far East, made contact with the research units in the Federation of Malaya, and in North Borneo and Sarawak.

Sir Neil Hamilton Fairley had the opportunity while in Singapore to discuss the progress of chemotherapeutic and insecticide investigations proceeding in Malaya with Dr. J. W. Field, the Director of the Institute for Medical Research.

9. The facilities of the overseas research units have been much used by specialist workers from the United Kingdom for the short-term study of specific problems. In addition to the participation in investigation overseas by certain members of the Committee, noted above, valuable studies were undertaken with the Loiasis Research Unit by Professor R. M. Gordon, Dr. W. E. Kershaw, Lecturer in Medical Protozoology at the Liverpool School of Tropical Medicine, and by Dr. C. A. Hopkins, delegated by the Department of Zoology at Glasgow University. Dr. N. A. Barnicot, Reader in Physical Anthropology in the University of London made specialist studies for a period of ten months with the Hot Climate Physiology Research Unit in Nigeria. Dr. R. Hewitt, an American authority on filariasis, spent some time in Tanganyika with Lt.-Col. W. Laurie, the Director of the Filariasis Research Unit there.

REGIONAL ADVISORY MEDICAL RESEARCH COMMITTEES IN COLONIAL TERRITORIES

10. An important landmark in the organisation of medical research in Colonial territories has been the recent institution, in East Africa and West Africa respectively, of a " Standing Advisory Committee for Medical Research ". The terms of reference of these two regional Committees are, in general, to advise on the needs and priorities for medical research within the respective regions; to keep current research activities under review, and to promote their co-ordination within the region and with research workers in the United Kingdom; and to advise on the means for ensuring that the results of research are applied in practice.

11. The membership of each of the Committees includes representatives of the Medical Departments and University Colleges of the Territories concerned, delegates from the Colonial Medical Research Committee in London, and in the case of West Africa a delegate from the Liverpool School of Tropical Medicine. In East Africa the Chairman is the Administrator of the East Africa High Commission; the Secretary is the Director, East African Bureau of Research in Medicine and Hygiene. In West Africa the Chairman is the Chief Secretary, West African Inter-Territorial Secretariat.

12. The inaugural meetings of the Committees were held during the year under review at Nairobi and Ibadan respectively. It is believed that the inception of these two regional committees will provide an efficient machinery for the organization of regional medical research in East and West Africa, and for relating it to local conditions.

REVIEW OF THE WORK IN PROGRESS

East African Medical Survey

13. The intention is that the work of the East African Medical Survey should be in phases, one closely following the other. They are:—phase I: the collecting of reliable vital statistics and the obtaining of information on the state of health and of sickness in each population under review; phase II: to investigate methods of control of the more important diseases; and, phase III: by " pilot " experiments to attempt control of such diseases. Housing and laboratories are being built at Mwanza, Tanganyika, an area typical of East Africa, with easy access to Kenya and Uganda. Work is at present in hand in three areas in Tanganyika and will begin shortly in Kenya.

The obtaining of information is by field teams, each consisting of a physician, a nurse, a laboratory technician, and ancillary staff. In each area chosen as suitable for a medical survey the following procedure is followed. A complete medical examination of at least one-tenth of the population and a nutrition survey are carried out; maternity histories are taken from each adult woman; births and deaths registers are maintained; dispensaries are set up; and laboratory investigations are made on all individuals medically examined. Such investigations include examinations of stools, urines, bloods, etc. All records are correlated and analysed by statistical staff. As far as is possible attempts are made to have local authorities supply information on agricultural and veterinary surveys of each area. By such means it is hoped to obtain a complete picture of the state of " health " and of disease of the people of each area surveyed. Areas for investigation are chosen by the D.M.S. of each Territory, and are always chosen with a view to phase III work as soon as possible. Investigations began in 1949, and the progress made is outlined below.

Area I: Ukara Island on Lake Victoria, with a population of 17,000 (500 per square mile). This area was chosen because of the poverty of the land and the people, and with the possibility later of attempting eradication of malaria vectors. Phase I work on this island has now finished. The most serious medical problem is malaria, which is hyperendemic. Both filariasis and schistosomiasis show a 30 per cent. incidence, but do not appear gravely to affect the infected. Hookworm is found only in two per cent. of the population, whereas over 40 per cent. of individuals had ascaris ova in the stools; these last two findings are the reverse of mainland findings. The Kahn reaction is positive in 15 per cent. of the population, and gonorrhoea is common. Food intake is low in quantity and ill-balanced. In spite of the many adverse factors, the population is increasing fast, with a net reproduction rate of near 1·6. Although they practise a remarkably advanced system of husbandry the population has reached saturation point. These findings

and those of a veterinary survey agree that the island harbours too many people and too few cattle. This first complete survey has proved the value of such work; contrary to expectations it has been shown that the major problems on Ukara are not medical. The immediate need is for large-scale resettlement, and this is now being considered by the Territorial Authorities.

Area II: Bukoba, on Lake Victoria, was chosen for study because it is peopled by an extremely wealthy tribe, thought to be dying out because of a high incidence of venereal disease, especially syphilis. The survey of this people is well advanced; although statistical analyses have not yet been done, the results show the tribe to be fast losing ground, with a net reproduction rate just below 0·8. The incidence of syphilis and gonorrhoea are high, but only slightly higher than in the flourishing related tribe on Ukara. The venereal diseases cannot be the major cause of the tribe's decline; the maternity records show that child-bearing stops in the female at about 25 years of age. The cause of the decline is probably the break-up of marriage which occurs around that age-group, due to the amoral habits of the males. In this aspect of the problem help has been requested from Dr. Audrey Richards and her workers from the Social Services Research Organisation at Makerere College.

As a control there has begun a phase III V.D. eradication campaign with funds supplied by the Territorial Government. Dr. McElligott of the Ministry of Health kindly advised on this problem on his recent visit to East Africa.

Area III: Kwimba, Tanganyika. This survey is in the important Sukumaland cattle area of Tanganyika. The area was chosen at the request of the Territorial Government, partly because of a high incidence of schistosomiasis and partly because it will be possible to integrate the survey findings with those of an intensive agricultural survey now being carried out in the same area by the Empire Cotton Board. In this area, as in others, the greatest difficulty is to determine the connection between parasitization and ill-health. A recording of the incidence of infection gives no information as to the effect of the parasite on its human host.

Area IV: Kisii, Kenya. Survey work has only recently begun in this area. It has been chosen to give a picture of a people living at high altitudes, and to ascertain the effect of a high endemicity of onchocerciasis on a population. Other work, which at present is only in a laboratory stage, includes investigations into the aetiology and treatment of tropical ulcer, and investigations on human schistosomiasis.

Publication

LAURIE, W.—(1952) "Annual Report of the East African Medical Survey Unit for 1951." East Africa High Commission, Nairobi.

Helminthiasis

(a) *Loiasis*

14. The permanent staff of the Loiasis Research Scheme at Kumba, Cameroons, has consisted during the year of Mr. W. Crewe, the entomologist, and Mr. P. J. Moore, the laboratory superintendent. Professor R. M. Gordon and Dr. W. E. Kershaw of the Liverpool School of Tropical Medicine and Dr. C. A. Hopkins of Glasgow University also paid visits of varying duration to the Cameroons and took part in different aspects of the work. Valuable part-time assistance was given by Dr. A. Zahra of the Cameroons Medical Field Unit.

During the past year the work on filariasis has been extended to include aspects other than loiasis.

15. *L. loa and its transmission by Chrysops.* It now seems certain that *Chrysops* originally was, and still mainly is, a forest dweller, existing in large numbers in the forest canopy. It is possible that the large numbers of *Chrysops* found biting man in and around the houses at Kumba occur there because the buildings are surrounded by tropical rain forest and are situated approximately at the canopy level. The discovery of vast numbers of *C. silacea* in the forest canopy, together with the finding at autopsies that a high proportion of some 250 monkeys (family *Cercopithidae*) showed the presence of filariae which were indistinguishable from *L. loa*, suggests that the human and monkey filarial diseases, and their mode of transmission, are probably related.

The bionomics of the main vector, *C. silacea*, are still being investigated, and although considerable knowledge has been obtained of the life-cycle under laboratory conditions, and of the relationship between the biting activity of the fly and microclimatic conditions, nevertheless some of the more fundamental aspects of the natural behaviour are still unknown. Thus, the male fly has not been captured in the field, nor is it known where mating and oviposition take place. It is unlikely that biological methods of control could be successfully applied until these and other problems concerning the life-cycle have been solved.

An attempt is now being made to elucidate the very early stages of development of *L. loa* in the mammalian host, and in this connection a study has been carried out of the biting mechanism of *Chrysops* and the bearing of this on the deposition of the parasite.

16. *A. perstans and its transmission by Culicoides.* The main breeding places of the supposed vectors, *C. austeni* and *C. grahami*, have been demonstrated in rotting banana stems, and it seems probable that the distribution of these two species is closely connected with the cultivation of bananas and plantains. It has been shown that *C. austeni* is much more abundant in the Kumba area than was previously believed, but since it bites only late at night it is not so often observed as is *C. grahami* which bites mainly at dusk and dawn. Various species of monkeys are being examined as possible reservoirs of *A. perstans*.

17. *Epidemiology of L. loa and A. perstans.* The results obtained from the earlier surveys suggested that the topographical features of certain areas of the Cameroons and the Niger Delta might have a critical bearing on the incidence of filariasis amongst the human population in such areas. During the period under review considerable further surveys were carried out, involving blood examinations of over 4,000 persons. The figures obtained from these investigations are still being analysed.

Publications

CREWE, W. and O'ROURKE, F. J.—(1951) " The biting habits of *Chrysops silacea* in the forest at Kumba, British Cameroons." *Ann. trop. Med. Parasit.*, **45**, 38.

DAVEY, J. T. and O'ROURKE, F. J.—(1951) " Observations on *Chrysops silacea* and *C. dimidiata* at Benin, Southern Nigeria. Parts I and II." *Ibid.*, **45**, 30 and 66.

GORDON, R. M. and GRIFFITHS, R. B.—(1951) " Observations on the means by which the cercariae of *Schistosoma mansoni* penetrate mammalian skin, together with an account of certain morphological changes observed in the newly-penetrated larvae." *Ibid.*, **45**, 227.

GRIFFITHS, R. B. and GORDON, R. M.—(1951) " A simple apparatus designed in order to observe insects feeding on living tissue, or the penetration of helminth larvae." (Lab. Dem.) *Trans. Roy. Soc. Med. Hyg.*, **44**, 355.

KERSHAW, W. E.—(1951) "*Loa* sp. in monkeys." (Lab. Dem.). *Ibid*, 44. —(1951) "Studies on the epidemiology of filariasis in West Africa, with special reference to the British Cameroons and the Niger Delta. II. The influence of town and village evolution and development on the incidence of infections with *Loa loa* and *Acanthocheilonema perstans*." *Ann. trop. Med. Parasit.*, 45, 261.

(b) *Filariasis*

18. This project began work in East Africa in June 1949. Its aims are to establish the relative importance of the filarial infections in East Africa and to investigate methods of control and treatment of these infections.

The filarial infections known to exist in East Africa include bancroftiasis, onchocerciasis and dipetalonemiasis. To establish the relative importance of these diseases it is necessary to find the incidences of infected individuals, and to assess the effect of infection on the individual. This means carrying out a survey through the three Territories. Originally two physicians were recruited for this laborious task, and the number was later reduced to one. One physician, one helminthologist, one entomologist and three technicians were recruited for work on treatment and control.

19. *Bancroftiasis.* The survey is behind its time-table, due to staff shortages; so far this work has been done only in Tanganyika. Findings there to date show that the incidence of infection is related to high temperature and humidity, i.e. that the incidence is high along the Coast and around the great lakes, whereas it is very low in the hot dry interior and in the high hills. This no doubt is related to the ease of development of the parasite in the insect vectors.

Two other facts which have so far emerged are: Firstly, the most important finding is that in East Africa bancroftian filariasis appears to cause no inconvenience to the great majority of infected individuals; it does not produce a symptom-complex like the "mumu" of the Pacific. Secondly, the incidence of late complications such as elephantiasis has been shown to be related to the intensity of infection in any area as distinct from the incidence, e.g. in the Kyela area of Tanganyika, where the microfilariae blood-levels are high, the incidence of elephantiasis is also very high compared with an area like Mwanza in which, although infection is common, the mf. blood-levels are low.

Microfilariae have been found in the bloods of two infants aged less than six months; previously the youngest reported case was three years of age.

20. The life-cycle in the vector has been studied. So far, even in work with *Culex fatigans*, the results are disappointing, with development of the parasite stopping at an early stage. Skin reactions and serological reactions have been investigated; the results are conflicting, and such methods of investigation appear to have no value as a method of diagnosis.

In the treatment of infected individuals, drugs which have been tested under field conditions include hetrazan, protostib, neostibosan, solustibosan and arsenamide. Details of findings are available elsewhere. The most promising drug is hetrazan, which affects not only the microfilariae but also probably the adult worm, certainly the female adult. The drug's effects on the infected individual are such that it can be used to eradicate infection in any area where such is thought necessary and where cheaper, easier methods are unsuitable.

Two other findings of importance are that, in spite of previous favourable reports from other sources, hetrazan is of no value in the treatment of established disease; and secondly, it has been shown that in Tanganyika it can be given in doses much exceeding those used by workers elsewhere. Its effectiveness as an ascaricidal agent has also been confirmed.

21. *Onchocerciasis.* As yet this disease has not been met with in Tanganyika. Work has begun in Kenya in areas known to be infected, i.e. in the hills to the north-east of Lake Victoria. Although the total areas affected are small in extent, inside these areas the problem is serious; over eighty per cent. of the population are affected, and, unlike bancroftiasis, in onchocerciasis even the early stage of infection cripples to a greater or lesser degree.

In view of the work of Garnham and McMahon on control of the vector, further work on this has not been undertaken. In this disease also, skin tests and serological reactions are of little practical value. Skin snips are helpful in diagnosis. One useful diagnostic method introduced is the reaction of the individual to a dose of hetrazan. All individuals suffering from onchocerciasis require treatment. The only drug found so far to have any value is hetrazan, but reactions are severe, especially the ocular manifestations. With the help of Dr. McKelvie of Kenya it has been shown that these ocular changes are only temporary, and that drug need not be withheld on this account. This important work continues.

22. *Dipetalonemiasis.* Field investigations so far have been limited to Tanganyika, and results show the distribution of the disease to differ markedly from bancroftiasis in that dipetalonemiasis is found in areas too cold for the transmission of bancroftian infection. Findings to date support the generally accepted view that dipetalonema infections do not harm man, and confirm that hetrazan administration appears to have no effect on the microfilariae or the adult worms. In view of the advanced stage of the work of Gordon and his colleagues in West Africa, work on the search for a vector has not been undertaken.

Investigations on hetrazan are at present limited to finding the most effective dosage schedule. Certain other drugs are being tested under field conditions.

23. An entomological survey is now being conducted on Ukara Island. This is a combined operation with the East African Medical Survey, the aim being to attempt vector eradication. To prevent confusion of results, the filarial infections have been dealt with by the use of drugs before vector eradication produces effects due to elimination of other insect-borne diseases such as malaria. This operation has also been designed to yield information on the relative costs of the two methods of eliminating filariasis.

Liaison has been close with all workers able to assist; the D.M.S. Kenya has been most kind in allowing us to work in close co-operation with Dr. McKelvie, (Ophthalmologist) and Mr. McMahon (Entomologist).

Publication

LAURIE, W.—(1952) " Annual Report of the Filariasis Research Unit, Mwanza, Tanganyika, for 1951." East Africa High Commission, Nairobi.

(c) *Guinea-worm*

24. Mr. S. D. Onabamiro of University College, Ibadan, has continued his research on guinea-worm in South-West Nigeria. In the first year of the work as recorded in the Report of last year 23 species of *Cyclops* were found in the ponds and streams of South-West Nigeria. In the past year the area under survey was more thoroughly examined and seven more species of Cyclops were found, bringing the total to thirty, of which seven are new species and two new sub-species.

25. A series of experimental infections carried out in the Laboratory on all these species of *Cyclops* under conditions as close as possible to those of the village ponds show that the following five species are well adapted for the transmission of the guinea-worm: *Mesocyclops leuckarti* (Claus), *Mesocyclops leuckarti aequatorialis* Keifer, *Thermocyclops nigerianus* (Kiefer), *Thermocyclops inopinus*

(Kiefer) and *Microcyclops varicans subaequalis* Kiefer (formerly indentified as *Microcyclops jenkinae* Lowndes and so reported in the last year's Report.)

26. In field work four of these species have been found to be naturally infected with the guinea-worm larvae in several village ponds used by the people. The one species which has not so far been found naturally infected is *Mesocyclops leuckarti* s. str. (Claus). A survey of the geographical distribution of the guinea-worm in South-West Nigeria shows that 85 per cent. of the area where the guinea-worm has a regular annual incidence lies in the middle belt of the country, a low tableland some 100 miles wide and rising between 600 and 1,000 feet above the sea-level; the southern border of this table land is about 60 miles from the sea coast.

27. The work has now shifted to the prophylactic side. Deep wells constructed to make human contamination impossible are being dug in several villages, and some of the new insecticides are being tried in some ponds to destroy the *Cyclops*. It is also contemplated that the work done in South-West Nigeria be extended later on to both the Northern and Eastern regions of Nigeria.

Publications

ONABAMIRO, S. D.—(1950) " A technique for studying infection of *Dracunculus* in *Cyclops*." *Nature*, **165**, 31. " On the transmission of *Dracunculus medinensis* by *Thermocyclops nigerianus* as observed in a village in South-West Nigeria." *Ann. trop. Med. Parasit.*, **45**, 1.—(1952). "Four new species of *Cyclops* from Nigeria." *Proc. Zool. Soc. Lond.*, **17**, 253.

Malaria.

Malaya

28. Dr. Edeson and Dr. Wilson of the Institute for Medical Research, Federation of Malaya, continued their studies on the chemotherapy of malaria.

29. *Chemoprophylaxis.* Direct supervision of experiments on the chemoprophylaxis of malaria on estates has not been possible, but blood-films are still sent to the Institute for examination from one estate where proguanil has been used for nearly five years. The malaria-rate for 1951 was considerably lower than in 1950. The results of chemoprophylaxis in a Malay rural area are described below.

30. *Chemotherapy.* A variety of drugs have been used in the treatment of 571 cases of acute malaria in the General Hospital, Kuala Lumpur, and the District Hospital, Tampin. The treatment of patients in Kuala Lumpur has proved that proguanil-resistant strains of *Plasmodium falciparum* are by no means confined to the Tampin district, although they do seem to be more prevalent there than elsewhere.

31. Proguanil-resistance in *Plasmodium vivax* has recently appeared for the first time. Judging by the Tampin experience, the widespread use of proguanil as a suppressive drug in a malarious area, taken largely without supervision, may result in the appearance of proguanil-resistant strains of *P. falciparum* in about two years, and of resistant strains of *P. vivax* in about four years. There is reason to believe that mosquito transmission of resistant strains is occurring in some parts of the country.

32. Single dose treatment with various chloroquine preparations indicates that 0.3 g. of chloroquine base should be the minimum dose for an adult Asian. Trials of a new drug " Daraprim " (pyrimethamine) in acute malaria have not been encouraging. A dose of 0.1 g. (given in two doses of 0.05 g. each at intervals of four to six hours) failed to cure the acute attack in three out of 16 mild infections

of *falciparum* malaria, and in those which were cured the disappearance of symptoms was noticeably slower than with single doses of chloroquine or camoquin.

33. *Malaria Control in Rural Areas.* An interim report for the period 1948–1950 has been submitted giving full details of the preliminary work and the results of the first 12 months of control. During 1951 there was a decrease of malaria in all four valleys, including the untreated comparison area; the parasite and spleen-rates of children 12 years and under examined at the half-yearly surveys are summarised below:—

Area	Number examined	Parasite rate per cent.						Spleen rate per cent.					
		Surveys						Surveys					
		1949		1950		1951		1949		1950		1951	
		1st	2nd	3rd*	4th	5th	6th	1st	2nd	3rd	4th	5th	6th
DDT	378–492	40	33	16	12	5	4	66	64	45	36	23	17
BHC	138–175	32	28	17	12	12	3	60	59	45	48	30	26
Proguanil ...	288–458	37	25	5	3	1	1	59	53	34	20	15	15
Comparison ...	273–337	28	24	17	24	18	9	54	54	49	51	34	40

* Control work started about four months before this third survey.

34. The fall in rates in the two valleys where the houses are being sprayed with residual insecticides has been slower than in the proguanil-treated area, but has been remarkably steady, particularly in the DDT area; the present indications are that a very similar end-point will be reached in each of the treated areas. Despite the unexplained drop in the latest parasite-rate in the comparison (untreated) area, the spleen-rate there has remained high. This effect on malaria in the two sprayed valleys has been accompanied by some reduction in the numbers of adult *Anopheles maculatus*, the vector species; the reduction has been more noticeable in the DDT valley. The numbers of larvae, however, show no marked change, and it is clear that residual spraying does not cause any dramatic reduction in populations of *A. maculatus*, which feeds freely on cattle and other animals, besides man.

35. *Effect of DDT and BHC on Malaya mosquitoes.* The Entomologists of the Institute, Mr. Wharton and Mr. Reid, have continued experiments on the lines reported last year. The work is partly supplementary to the house-spraying programme described in paragraph 34. Tests with window-trap huts to compare the effective duration of different doses of DDT and BHC as wettable powders against *Anopheles maculatus* were only partially successful because of the small numbers of *maculatus*. The results confirmed that DDT at 200 mgm. per sq. ft. and BHC at 40 mgm. gamma isomer per sq. ft. are effective for nearly six months (24 hour mortality not lower than 50 per cent.), but suggested that lower doses (DDT 100 mgm., gamma BHC 10 mgm., per sq. ft.) lasted only about two months against *A. maculatus*. The 10 mgm. dose of gamma BHC killed *Culex fatigans* for about one week compared with about six weeks with a 40 mgm. dose. Tests, also with a window-trap hut and wettable powders, against *Anopheles sundaicus*, the brackish water malaria carrier, showed that with gamma BHC at 40 mgm. per sq. ft. the 24 hour mortality had dropped below 50 per cent. after two months, and with DDT (200 mgm.) after three months. This is only about half the duration of these doses against *A. maculatus*.

36. The effect of house-spraying upon *Anopheles maculatus* cannot be judged by any method of daytime catching in houses because it does not rest indoors by day.

However, last year in the houses of the experimental valleys where *A. maculatus* is the vector, small numbers of other species, chiefly *A. vagus* and *aconitus*, were found by day. They were even found on surfaces sprayed only one month before with gamma BHC at 40 mgm. per sq. ft., but most of these mosquitoes died in the next 48 hours, if caught by hand and kept in the laboratory; while the mortality among those from unsprayed houses was only about half as much. This investigation has been continued, and though hampered by the low numbers of mosquitoes, the results suggest that BHC has a slight effect upon *A. vagus* and *aconitus* after four months, but practically none after six months. This is a shorter duration than would be expected from the results with *A. maculatus* in window-trap huts (six months). Possibly BHC does not last as long against *vagus* and *aconitus*, but the malaria figures (see table in para. 33) and the numbers of adult *maculatus* caught suggest that it has not in fact been quite as effective as DDT against *A. maculatus* in these village houses, although equal to DDT in the trap-hut trials. Houses sprayed with DDT have remained almost free of resting mosquitoes for six months, after which they are resprayed. These results confirm the irritant effect of DDT upon mosquitoes, and the virtual absence of such effect with BHC.

Publications

WILSON, T., EDESON, J. F. B., REID, J. A., and WHARTON, R. H.—(1951) " Interim report to the Colonial Insecticides, Fungicides and Herbicides Committee, and the Colonial Medical Research Committee, on experiments in rural malaria control in Malaya, 1948–1950." Report No. 19 of the Institute for Medical Research, Kuala Lumpur.

REID, J. A.—(1951) " Effects of DDT upon different mosquitoes in Malaya." *Nature*, **168**, 863.

WHARTON, R. H.—(1951) " The behaviour and mortality of *Anopheles maculatus* and *Culex fatigans* in experimental huts treated with DDT and BHC." *Bull. ent. Res.*, **42**, 1.—(1951) " DDT and BHC as residual insecticides in Malaya." *Nature*, **167**, 854.

37. Additional malaria investigations, not financed from Colonial Development and Welfare funds, have also been carried out at the Institute.

Evidence of exo-erythrocytic schizogony in small mammals infected with *Hepatocystes*, already reported in certain Malayan squirrels, is now apparent in bats. The schizonts in the bat liver resemble those described by Ray in the Himalayan Flying Squirrel. Presumptive liver schizonts have been seen, too, in the liver of a monkey (*Macaca irus*) with parasites in the blood indistinguishable from *P. knowlesi*.

In the Division of Entomology practical methods of using DDT as a larvicide are being studied; a suitable emulsion has been devised and a low-pressure sprayer for applying the solution in oil is under trial. Studies of the feeding and resting habits of adult mosquitoes have been extended to include the malaria vectors of the coastal plains; an account of the systematics and biology of the *hyrcanus* group of Anopheles awaits publication; and an interesting collection of *Simuliidae* from both highlands and lowlands is ready for further study at the British Museum. Attemps to find the vector of the squirrel malaria parasite, *Hepatocystis malayi*, have been unsuccessful.

North Borneo

38. Malaria research has progressed during the year in the three territories of North Borneo, Sarawak and Brunei. Labuan has continued to show itself an ideal centre for communications and a fruitful source of material, and routine work has therefore continued there, with the systematic study of Borneo anopheles and the

collection of information from Borneo generally. Work has continued at Tambunan in the interior of North Borneo, and extensive surveys have begun in Sarawak and Brunei. *Anopheles balabacensis* (i.e. *A. leucosphyrus*) has continued to show itself the chief vector in every area so far studied in North Borneo, Sarawak or Brunei where conclusive evidence has been obtained. The impression is being gained that *A. umbrosus*, although incriminated in the past by dissection, is in fact not of great importance; and the evidence regarding *A. sundaicus* remains conflicting and inconclusive.

39. *The Tambunan Experiment.* At Tambunan, 18 months after the initial experimental jungle clearance for the eradication of *A. balabacensis* and the malaria which it carries the results were encouraging, although not yet conclusive. In a larval survey, of 83 potential breeding places examined, only four yielded *A. balabacensis* in a ten-minute search of each, with a total of only nine larvae in a five-day search.

The spleen surveys showed a fall in the " All Ages " grouping from 66 per cent. in 1949, to 52 per cent. in 1950 and 45 per cent. in 1951; and in the " 2–10 year " age group, from 80 per cent. in 1949 to 53 per cent. in 1951. Figures for the Comparison Area remained high, and exactly what they had been, i.e. 74 per cent. for all ages, and 100 per cent. for the 2–10 age group. Thus, while the figures cannot yet be considered to be anything like conclusive, they do support the belief that localised clearing of shade is an effective means of malaria eradication for Borneo generally.

40. *Sarawak and Brunei Surveys.* An extensive survey has begun of the States of Sarawak and Brunei, to define the distribution and intensity of malaria, and if possible the identity and distribution of the vectors. Surveys have been completed of the State of Brunei and the 5th Division of Sarawak, travelling largely up the rivers, and more intensive entomological examinations are being carried out in selected situations. With one or two interesting exceptions, an analysis of malarial intensity according to the type of country has shown a sharp cleavage between the high spleen-rates, averaging over 60 per cent. wherever there are jungle-covered hills, and the very low rates, averaging six per cent. found on flat open land. This is strong indirect evidence that *A. balabacensis* is the vector throughout all the areas examined, and this evidence is strengthened by the results of superficial larval surveys and by preliminary dissections.

41. *Residual Spraying Experiments.* Work carried out last year, which suggested that DDT in kerosene is repellent to *A. balabacensis*, is being extended to study the effects of other contact insecticides on *A. balabacensis* and other possible vectors. An experimental hut has been erected, and trapping is being carried out. It is hoped that this will yield results which will throw light on the possible value of residual spraying in Borneo, but results have been delayed owing to a prolonged drought.

42. *Entomological Research.* This has continued on the systematics of *A. leucosphyrus* and related forms, and a thorough revision of the group is nearing completion. Field work has been carried out in Brunei, Sarawak and Banggi Island, North Borneo, to collect material and information.

Publications

COLLESS, D. H.—(1950) " The identity of the malaria vector, *A. leucosphyrus*." *Indian J. Malariology*, 4, 377.—(1951) " New Methods for mounting Mosquito Larvae." *Ibid.*, 5, 183.

MCARTHUR, J. A.—(1950) " Malaria and its vectors in Borneo." *Ibid.*, 4, 1. —(1950) " The importance of Borneo anopheles." *Ibid.*, 4, 391.—(1951)

" The importance of Anopheles leucosphyrus. ' *Trans. R. Soc. trop. Med. Hyg.*, **44**, 683.

Gold Coast

43. Dr. R. C. Muirhead-Thomson was transferred from Jamaica to the Gold Coast during the year, and has taken up studies on the local vectors of malaria, largely in relation to the observations made by him in the West Indies. In the course of the Malaria Research Scheme in Jamaica which terminated in April 1951, two new factors came to light, factors possibly of wider import in the problems of malaria epidemiology in general. Observations on *Anopheles albimanus* in Jamaica, and to a less extent on *A. aquasalis* and *A. bellator* in Trinidad, revealed the very uneven distribution of anopheline bites and feeds among the village population; the older children and even more so the adults providing the great bulk of the mosquito blood-meals in nature. A series of experimental infections of Anopheles from *Plasmodium falciparum* gametocyte carriers confirmed other workers' findings about the absence of any simple direct relationship between the intensity of the gametocyte infection in the human, and the actual infectivity to the mosquito. In addition, infections were produced in mosquitoes from particular gametocyte carriers whose gametocyte density at the time of feeding was so low that routine examination of 150–200 thick film fields might fail to reveal a single parasite, and result in the slide being dismissed as negative.

44. With these two factors in mind the work is now being continued in West Africa in an attempt to throw more light on the true reservoir of malaria among the population of a hyperendemic African village; that is to say how much each human age group contributes to the natural infections in *Anopheles gambiae, melas,* and *funestus*. Some of the findings in Jamaica have already been followed up by the Medical Entomologist in Sierra Leone, who has found that *Anopheles gambiae* shows the same tendency to feed mainly on the older age groups, infants being bitten very much less frequently even when asleep at night. In the present investigation, centred in Accra in the Gold Coast, it is hoped to repeat and extend these findings on the local malaria vectors, paying particular attention to the distribution of blood feeds rather than bites, as it has been observed that with infants in particular the mosquito is not always able to follow up the bite with a blood meal.

45. As to the actual infectivity of each human, this can only be determined conclusively by experimental feeds with laboratory-bred anopheles. Work on these lines has already started near Accra. The aim is to find out what proportion of each human age group is actually infective to anopheles, and then find to what extent these age groups provide blood-meals for anopheles in nature. What appear to be suitable localities for these experiments have been selected in villages round Sakumo Swamp immediately west of Accra. To what degree this rather ambitious project will succeed will of course be determined mainly by the degree of co-operation from those African villagers.

46. As the vectors of malaria in West Africa are also vectors of *Filaria bancrofti* it is hoped that in the course of the main work on the reservoir of malaria some idea may be gained about the human origin of the high proportion of filarial infections which have already been found in the local anophelines.

Publication

MUIRHEAD-THOMSON, R. C.—(1951) " Mosquito behaviour in relation to malaria transmission and control in the Tropics." Edward Arnold, London, 213 pages. —(1951) " Studies on salt-water and fresh-water *Anopheles gambiae* on the East African coast." *Bull. ent. Res.*, **41**, 487.

Trinidad

47. Mr. Senior White, the entomologist, Malaria Division, Trinidad, has continued the various research projects on malaria which have been in progress and has taken up some new lines of work. Included is an animal diversion experiment based on the recognition of the fact that *A. aquasalis* prefers to feed on oxen and horses rather than on man. Man-baited traps were employed around which 0 to 3 oxen were tethered, the blood meals of mosquitoes subsequently caught being determined by precipitin tests. As the number of precipitin tests which could be undertaken in relation to the investigation was unfortunately restricted, it was not possible to ascertain on a sufficient scale the extent to which mosquitoes had fed on the bait-men or on the diversionary animals. The large-scale ox-diversion and scrub-eradication programme proposed for trial at New La Paille has been indefinitely postponed. The child spleen and parasite-rates of the villages were, at the first examination in September, 1951, no more than 4·7 per cent. and 3.0 per cent. respectively. At such values any reduction resulting from the proposed experiment would be inappreciable to the layman. Were there not a limit on the number of precipitin tests which can be carried out, the results of diversion and scrub-clearing could probably be measured by the results of these.

48. Dr. Kellett, of the Malaria Division, is carrying out a monthly child-parasite survey and biannual parasite surveys of the entire population. Infants up to 12 months of age are being recorded separately, so that it may be found whether there is now in any month active transmission.

Adult mosquito density measurements, both by scrub-catches and the local dawn-traps, are being continued. The studies on anopheline breeding in mangrove and grass zones have been continued. The filling, draining and oiling of all breeding-places in the open grass stretch north of the Laventille mangroves have been completed, and the area will be maintained until the experiment terminates at the close of 1952. The effect on mosquito density in the suburban Success area above the swamp is being observed. In the above connection a 600-foot transect survey of the northern strip of the Laventille mangroves was run through the year. Quite considerable breeding was found, save in the western third where there is probably more tidal action than further east. Considerable adult-resting was found in these mangroves, nearly all males; an indication that the female population proceeds forthwith to the suburban area; hence the trap watching the area shows little reduction over the time before the grass strip was sanitated. From the opening of the base line traps in 1948 up to the end of 1951 production of *A. aquasalis* has shown a steady decline, being in 1951 half of that of 1948. This is not a DDT effect. It remains to be seen whether it is due to the much heavier rainfall in the last two years (no true dry season), or to a definite long-run cycle of abundance of unknown causation.

49. A second year's study of rice field production was carried out in rice adjacent to the mangrove face where anophelines other than *aquasalis* are rare. Observations on swarming and mating of *aquasalis* were carried out every week in extension of previous work. Swarming and resting were found everywhere save over the grass verge to the mangroves, and here the act was found in open areas in the mangrove itself.

In relation to the point which has been raised by Dr. Muirhead-Thomson regarding the different chemical conditions in permanent and temporary pools and their effect on breeding, a request has been made for the assistance of a chemist to study the matter in relation to the reduced mosquito output during the last two wet years.

50. Preparations are being made to repeat Dr. Muirhead-Thomson's trap-hut experiments carried out with *A. gambiae* and *melas*. Huts are being built near the Insectary, on the African model, in which the natural behaviour and the effects

of DDT and BHC will be studied numerically. If the results in the first year seem to be worth-while, the wattle and daub huts will be replaced by wooden huts more comparable to West Indian housing. This experiment will start with the rains. The Insectary has furnished some useful longevity data, but there has been no success in the establishment of a cage colony. To raise the roof another 10 ft., to conform with the usual 15 ft. height now found for the formation of an *aquasalis* swarm, will be costly. It is doubtful whetner success will ever be achieved. Even larvae transferred from pools in the open to the wells in the cage do not do well, and the phenomenon of poor breeding in permanent water may apply. As regards longevity, unfed but mated females caught from a dawn-trap specifically modified to catch such, and introduced into the cage with its calf, all die out between a maximum of ten and a minimum of five days, indicating the very short life of local *aquasalis* in nature, and explaining its very poor vectorial capacity.

51. A ten day visit was paid to St. Lucia with four fieldmen for the purpose of examining the local anophelines. It was clearly shown that *A. aquasalis* of the Windward Islands is biologically different from that of Trinidad as originally distinguished by the two maxillary indices. A further study is desirable. Mr. Senior White has completed for publication an extensive report on his studies on bionomics of *A. aquasalis* based on his investigations in Trinidad during the years from 1947 to 1950.

Nigeria

52. Dr. L. J. Bruce-Chwatt, Director of the Malaria Service, Nigeria, has submitted the following report on the research work of the Service.

53. A long-term investigation that began in 1948 was completed. The conclusions are:—

(*a*) The mean incidence of malarial parasitaemia (mainly *P. falciparum*) in a sample of 323 African parturient women was 33·0 per cent., a rate somewhat higher than the usual parasite-rate of the indigenous adult population. The incidence of the malaria infection of the placenta was 23·8 per cent. There were no cases of congenital malaria in 332 babies born of African mothers.

(*b*) The mean birth-weight of 237 newborn connected with non-infected placentae was 150 grams higher than the respective weight of 73 newborn whose placenta was found to be infected. This difference, though small, is statistically significant. There was no apparent correlation between the neonatal mortality and the infection of the placenta.

(*c*) Periodical investigation of a sample of 138 African infants followed up from age of about one month through the first and part of the second year of life, has shown that the mean parasite-rate, due principally to *P. falciparum*, increases from 3.0 per cent. during the first quarter, to 20.0 per cent. during the second quarter, to 60.0–70.0 per cent. during the next two quarters and to over 80.0 per cent. thereafter. The infection-rate calculated in relation to the known length of exposure shows that an equally long exposure leads to a different frequency of infections in various age-groups of the investigated sample of infants, and that in the 1–3 months age-group the parasite-rate is significantly lower than would be expected.

(*d*) Mean weight-curves of infected and non-infected infants show a considerable " flattening out " at about five months of age and thereafter. The ascending trend of the curve in the infected group is much less pronounced.

(*e*) Taking individual weight-curves as a gauge of growth and development, there are surprisingly wide individual differences in the way African infants react to their first infection with the malaria parasite. In a followed-up group of 64 infected,

untreated African infants some 15 per cent. showed a considerable deleterious effect of the first infection with *P. falciparum*, about half of the group showed only a transitory effect of the infection, and in 18 per cent. there was little or no effect of the occasionally heavy infection on the weight curve. Observation of the latter group suggests an existence of an inherited, transient, passive immunity against malaria.

(*f*) Records of 3,540 children's autopsies carried out in Lagos during the period 1933–1950 showed that acute malaria can be incriminated as a direct cause of death in 9 per cent. of infants, in 14 per cent. of children between 1 and 4 years of age, in 9 per cent. of children between 5 and 7 years of age, in 4 per cent. of older children and in 2 per cent. of adolescents.

(*g*) The computed age-specific malaria-mortality figures, expressed per 1,000 Africans exposed to risk, gave for the infants a rate of 10 per 1,000, for small children—a rate of 7 per 1,000; for older children—a rate of 1 per 1,000; and for adolescents and adults a rate of about 0.3 per 1,000.

(*h*) It is estimated that deaths due to malaria in the Nigerian population under 15 years of age amount to at least 35,000 per annum.

54. *Ilaro Experimental Malaria Eradication Scheme:* The experimental eradication scheme instituted at Ilaro (Southern Nigeria) aims at implementation of the suggestion of the Expert Committee on Malaria of the World Health Organization of 1948. The choice of the area was based on the following principles:

(*a*) Situation within the hyperendemic zone, with *A. gambiae* and *A. funestus* as main vectors.

(*b*) Availability of the preliminary survey of the area to estimate prevalence of malaria and the density and infectivity of the vectors during each season of the year.

(*c*) Possibility of institution of a long-term residual spraying project with follow-up of the anopheline density and distribution, and of the prevalence of malaria.

The Scheme commenced in February, 1949 when Ilaro, a medium-size Yoruba town in South-Western Nigeria, was chosen for an experimental " island " malaria eradication. Ilaro has some 12,000 inhabitants and 2,300 houses, and is a typical mixed urban and rural community, situated within a geographical zone that corresponds to hyperendemic malarial conditions in Africa. A preliminary malaria survey carried out between March, 1949 and March, 1950 revealed that malaria in Ilaro is on the hyperendemic level, with a pronounced largely sub-clinical endemic wave that starts shortly after the beginning of the rainy season and lasts for at least four months. *P. falciparum* is the main parasite species with the concomitant *P. malariae* and (rarely) of *P. ovale*. *A. gambiae* and *A. funestus* are the main vectors, with *A. funestus* persisting throughout the year, while *A. gambiae* has a pronounced seasonal peak during the rains.

55. The residual spraying commenced in March, 1950. The insecticide used is the BHC wettable powder P.520 containing 6.5 per cent. gamma isomer. The original dosage of 10 mgm. gamma isomer per square foot was increased to 15 mgm. Eclipse " Super Triumph " bucket-sprayers (stirrup-pump pattern) with a 20 foot hose are used, trigger release and straight nozzles provided with a disc of three sixty-fourth inches aperture giving a flat fan-shaped swathe. There are four spraying squads, each composed of one recorder and four sprayers. The spraying of the 2,300 houses containing over 11,000 rooms is repeated every three months. All hamlets within a three miles area are also treated. No larvicidal control is being carried out and the known anopheline breeding-places are routinely checked and records kept of the species and density of the breeding activity. The results of the residual spraying are being assessed by means of entomological (anopheline

density, larval density, infectivity rate of anopheles) and malariometrical (spleen rates, parasite-rates, parasite-densities, morbidity, etc.) data. Seven spraying phases have been completed; the eighth is now in progress.

56. It is still early to assess the results of this scheme which must last for three full years before valid information is obtained. The preliminary results can be summarized as follows :—

(1) There was a spectacular decrease of adults of *A. funestus*, one of the two main vectors of malaria throughout Africa. The average number of adult *A. funestus* collected per Capture Station room/day has dropped from 2.5 in 1949 to 0.01 in 1950 and 0.005 in 1951. The amount of larval breeding of this particular mosquito decreased from about 20 larvae per 100 dips in April–May, 1950 to 0 to 0.02 during the period June, 1950–December, 1951.

(2) Comparative figures for *A. gambiae* were 3.3 adults per Capture Station room/day during the second half of 1949, 0.2 during the corresponding period of 1950, and 0.4 during 1951 (with a sudden peak of 1.4 in November 1951). The larval index for *A. gambiae* has decreased from 150 per 100 dips in April 1950 to about 10 for the last six months of 1950. It rose, however, to about 18 after the prolonged rainy season of 1951.

(3) The infectivity of *A. gambiae* fell from the average monthly 6.3 per cent. during the last half of 1949 to an average monthly 3.3 during the corresponding period of 1950 and to 0.12 for 1951. The infectivity of *A. funestus* fell spectacularly from an average 3.5 in 1949 to zero in 1950 and in 1951.

57. The decrease of malariometrical indices in the local population is disappointingly slow, but this is not entirely unexpected. The most pronounced reduction of the parasite-rate occurred in the very young; in infants, from about 40 per cent. in 1949 to 11 per cent. in 1950, and to 9.8 per cent. in 1951; in children between 1 and 2 years of age, from 80 per cent. in 1949 to 50 per cent. in 1950, and to 37 per cent. by the end of 1951. The parasite-rate in the 3–4 and 5–7 age groups fell from 70–75 per cent. in 1949 to 50–60 per cent. by the end of 1951. In the adolescent group the decrease is less marked, and there is hardly any difference between the adult parasite-rate in 1951 as compared to 1949. Monthly data are being analysed. There was during the last months of 1950 and 1951 a considerable reduction of malaria morbidity recorded at the Ilaro dispensary.

58. It is interesting to note that the registry of vital statistics of the Malaria Service at Ilaro has shown during 1951 an increase of live births as compared with 1949 and a considerable decrease of general and infant mortality. The scheme is operated by the Malaria Service entirely out of its expenditure under the Colonial Development and Welfare Scheme. Its average cost is £3,000 per year, or 5s. per head of the local population.

59. *Field trials of new antimalarials.* An investigation of the schizonticidal activity of a new compound of the series of 2, 4-diamino-pyrimidines (2, 4-diamino 5-P-chlorophenyl 6 ethyl pyrimidine known under its first code name as " B.W.50-63 " and subsequently as " Daraprim ") was carried out on a number of selected African school children infected with *P. falciparum* and *P. malariae*. The speed of the schizonticidal effect of the new drug on trophozoites of *P. falciparum* was comparable with that of mepacrine, but the effective dose per child was as low as 5 mgm. The schizonticidal action on *P. malariae* was slower than on *P. falciparum*, and no gametocidal action on *P. falciparum* was evident. No toxic effects were observed.

60. *Research on insecticides.* Trials on insecticides have been carried out within

the framework of the Ilaro Scheme. Biological assays using *Aedes aegypti* and *Anopheles gambiae* as test insects were carried out on the walls of inhabited houses, and also on sun-dried bricks made from Ilaro mud. Preliminary results suggest that the duration of toxicity of BHC deposits on the walls of inhabited African village houses is much less than that exhibited in experimental huts. In the case of BHC deposits equal to 15 mg. gamma BHC per sq. ft., the average mortalities shown by *Aedes aegypti* fall to 50 per cent. of their original 100 value, by the fourth to sixth week after application.

Similarly Dieldrin in an inhabited building showed a duration of toxicity much shorter than observed in laboratory experiments elsewhere, mortalities falling to 50 per cent. by the eighth week with a dosage of 100 mgm./sq. ft. Chemical assays show that the BHC dosage aimed at is in fact attained, and indeed usually surpassed, but that less than 50 per cent. of the original deposit is detectable by the fourth week. After this period the loss of BHC appears to be more gradual.

61. *Mosquito bionomics.* An investigation of the ecology of crabs on the Lagos sea-shore and problems created by mosquitoes breeding in crab burrows was completed and published. *Gelasimus tangeri* (the fiddler crab) and *Cardiosoma armata* (the edible land crab) are the main crustacea responsible for burrowing deep shafts in which larvae of several culicines (particularly *C. thalassius* and *A. irritans*) breed in considerable numbers during the rainy season and create in some coastal areas a substantial public health problem. Larvicidal pellets (made of Gammexane wettable powder, cement and sand) dropped into the crab burrows stop the breeding of larvae for three-four months.

62. Other investigations comprised a survey of blood-parasites of wild rodents of Southern Nigeria, field trials of herbicides against *Pistia stratioites*, field tests of new spraying equipment, surveys of various areas in Nigeria (Edoshigi, Badeggi, Keffi, Lake Chad), and control projects (Port Harcourt, Kano Airport).

Publication

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East Africa

63. The beginning of the year 1951 found the East Africa Malaria Unit in the process of transfer to Amani from Muheza, both in Tanganyika, leaving a small low-level field research station at Muheza. This consists of a laboratory, two European houses and six quarters for African technical staff; while at Amani there are four laboratories for professional officers, a teaching laboratory, and a library and museum building, with houses for the four Europeans living there, a rest-house, and the necessary quarters for African maintenance and technical staff. This partition of the unit affords the best of both worlds: the lower station with a coastal climate and therefore a high incidence of mosquitoes, malaria and other endemic diseases, and the higher with its cooler environment in which administration, laboratory investigations, teaching and other mental activities can be carried on with a much higher degree of efficiency.

64. By the beginning of March the European staff was completed, and the African staff has been filled during the course of the year. As a result the activities of the Unit have had an increasing tempo, and progress has been made along all

the lines on which its work has been planned. Building modifications were completed in time to hold a first Inter-Territorial training course for Africans in May, and a second larger one was held in October. These were concerned with malaria only, and the teaching covered the life-history of mosquitoes, their identification, and the detail of methods for their control under varying conditions. Other methods of extending knowledge were by the production of pamphlets, newspaper articles and bulletins on various aspects of malaria and its control.

65. While the establishment of the running of the Unit and the move to a new station occupied a good deal of the time of the Director, it has been possible to do a fair amount of touring in the East Africa territories, and in the course of these tours advice has been given on local problems; and knowledge of the distribution of malaria, and its varying incidence, extended. Much written advice on various problems has also been given to different agencies concerned in the prevention of malaria from time to time. In all these activities close liaison is of course maintained with the several Medical Directorates, as well as with those High Commission research units the activities of which have anything in common with those of this Unit.

66. Apart from teaching, the Entomologist has been fully occupied with investigations into the habits of adult anopheline carriers of malaria, at Muheza. These researches have been particularly concerned with the frequency of feeding by female anopheles, the length of time that elapses both between feeds and their laying of eggs, the proportion of their time that they spend out-of-doors, and the search for a method of ascertaining the average age of a mosquito population. All these are matters of great practical significance to the successful application of control measures, and in particular to the method of residual impregnation of houses with insecticides.

67. At the end of the year information was received of the recommendation by the Colonial Medical Research Committee of a project for the investigation of the effect of malaria on the communities in which malaria transmission is most intense, and the provision of research funds made by the Colonial Office for the execution of this project will greatly increase the responsibilities of the Unit, and the contribution that it may be expected to make to the advancement of knowledge of malaria and its control.

Virus Diseases

(a) *The West African Virus Research Institute, Lagos, Nigeria*

68. The Virus Research Institute has continued its programme of research on neurotropic viruses, yellow fever and rabies. It has also, on request from various sources, undertaken investigations and research outside its original programme. The most notable of these was the work in the Gold Coast and in Onitsha Province on outbreaks of yellow fever experienced there, and on the use in both places of the yellow fever vaccine produced by the Pasteur Institute at Dakar. In Onitsha Province field trials were made of the effect of aureomycin on yellow fever; no beneficial effect either on the clinical course of the disease or on the level of viraemia was noted, although the number of cases treated was small. During the course of the epidemic, viscerotropic yellow fever virus was isolated from 36 patients on a total of 51 occasions; the maximum titre of circulating virus found was 1 in 128,000. In addition to the cases diagnosed by virus isolation, 14 other cases were confirmed as a result of serological studies. A thorough investigation was made in Enugu of cases of encephalitis developing as a result of Dakar yellow fever vaccine, and a paper on this subject is being prepared for publication. Yellow fever vaccine prepared by the Wellcome Foundation for Medical Research, London, is being received and distributed to Nigeria, and tested for potency in this Institute. Sera

have been received from Sierra Leone, the Gold Coast and Nigeria for routine testing by the yellow fever mouse-protection test, and a number of histological sections of liver tissue were received for consultative opinion as to the diagnosis of yellow fever.

69. Work on the distribution of protective antibodies against viruses of Bunyamwera, Bwamba fever, Mengo encephalomyocarditis, Semliki Forest, Uganda S., West Nile, Yellow Fever and Zika has continued, and in the course of this work it has been found that there is a slight relationship between Uganda S and yellow fever viruses. There is a definite suggestion that yellow fever immunity in man may enhance immunity to Uganda S, although there is no indication that immunity to Uganda S enhances immunity to yellow fever. Tests made with the live avianised rabies vaccine prepared by the Lederle Laboratories have shown that it retains its potency well over a long period, and that it is potent against the Nigerian strain of street rabies virus. Two strains of Herpes Simplex have been isolated during the year, and a virus which has so far not been identified was isolated from a horse with encephalitis. Work was also done on the development of neutralising antibody and the transmission of louping ill.

70. The Institute has been appointed a W.H.O. Influenza Centre and is undertaking research work on the epidemiology and virology of influenza. Parallel with these investigations, research is being carried out on the possible virus etiology of certain non-malarial short term fevers.

In pursuance of the policy that this Institute is to become a centre of medical research in West Africa, present facilities are being continually expanded. This leads to apparently high overhead expenses when the present small professional staff only is considered. Nevertheless, it is fortunate that this year more technical staff have been appointed, so that it is now possible to make use of most of the available facilities without leaving any unexploited.

(b) *The East African Virus Research Institute, Entebbe, Uganda*

71. In accordance with the general policy of the Institute mentioned in the 1950 Annual Report, the research activities during 1951 have in the main represented a continuation of the 1950 programme. The most important has been the association of the Institute with the World Health Organization-sponsored scheme for delineating the southernmost boundary of the yellow fever area in Africa. Under an agreement with the Director-General, World Health Organization, the Institute has undertaken the examination of human bloods up to a total of some 7,500 tests from the Belgian Congo, Angola, Tanganyika, Northern Rhodesia and Nyasaland. All laboratory expenses incurred in these tests will be reimbursed by World Health Organization. Up to the end of December, some 4,000 bloods have been received, of which 1,932 have been tested. Positive sera came from Barotseland, Northern Rhodesia, 12·2 per cent., and from Lilongwe area, Nyasaland, 1·5 per cent. Small preliminary surveys carried out between 1943 and 1945 also showed some positive results, and the evidence suggests that endemic yellow fever exists in these areas.

72. Other work on yellow fever included:—

(*a*) An immunity survey made in Western Uganda to ascertain the persistence of immunity following vaccination with the standard 17D vaccine. The results suggested that the validity of yellow fever certificates might be extended up to at least nine years after vaccination.

(*b*) Vaccination by scarification with a combined yellow fever 17D smallpox vaccine. The percentage of successes with the yellow fever vaccine component was not sufficiently high to suggest that the method be used routinely.

(*c*) *Animal yellow fever in dry areas in Kenya and Uganda.* The results strongly suggest that in these areas the monkey is replaced by the bush baby (*Galago*) as the principal animal host of yellow fever, and that in such areas negative results from monkeys must not be accepted in the future as a reliable indication of the presence or absence of the virus.

73. *Viruses other than Yellow Fever: Uganda S and Zika.* These viruses have been isolated during the course of yellow fever investigations, and several papers on them have already been published or are in press. A general summary will be found in the 1951 Report.

Mengo Encephalomyelitis Virus. Further work on this virus has confirmed recent American investigations as to the important points played by rats in the spread of the infection. Thus five out of 47 sera of *Rattus rattus kyjabius*—a species closely allied to, if not identical with *Rattus rattus*—were positive. Experimental work during 1951 showed that rats inoculated by different routes showed no signs of illness, but developed immunity and continued to excrete the virus in faeces and/or urine for at least 15 days. Monkeys could also be readily infected by feeding them with the virus. Although the virus has been isolated from batches of *Taeniorhynchus* mosquitoes (see 1950 Report), transmission experiments—by allowing infected mosquitoes to bite monkeys—have failed. The present evidence suggests that the rat is the natural host of the virus and that infection of other animals, including man, may be due to accidental contamination of food or water with rat excreta. If this hypothesis be proved correct it is probable that the mosquitoes were merely carrying the virus mechanically, having picked it up from infected monkeys.

74. *Poliomyelitis* (*Infantile Paralysis*). Much attention has been recently given to the immunity status of isolated communities in different countries. On the request of the Director, Poliomyelitis Research Centre, Johns Hopkins Hospital, Baltimore, U.S.A., bloods were collected from several isolated areas in Uganda and elsewhere and sent to him for examination. The first results have just been received and are of great interest. The bloods contained antibodies against the three recognized types (Lansing, Brunhilde and Leon) of poliomyelitis, although clinical cases appear to be extremely rare in the community.

Rickettsioses (*Typhus Infections*)

75. The occurrence of comparatively few cases of murine (rat) typhus in Mulago Hospital and of still fewer cases of tick typhus, while gratifying to the Public Health Authorities, naturally hindered laboratory studies. Attempts were made to isolate in guinea-pigs the organisms from three suspected cases of tick typhus, but none was successful. Little is known of the frequency of the different types of human rickettsial infections in the Mengo district of Uganda, and it was thought that a survey of a random sample of the population would prove of interest. A total of 560 sera was examined by the complement-fixation test; of these, 13 gave positive reaction to tick typhus, but the reactions to epidemic typhus, murine typhus and Q. fever were completely negative. In view of the not uncommon occurrence of murine typhus and the apparent rarity of tick typhus amongst the local African population, the results were unexpected; and until further data are available they should be regarded *sub judice*. Other work included attempts to isolate the organisms from local ticks (mainly different species of *Rhipicephalus*). Batches were inoculated into guinea-pigs as detailed in the 1950 Report, but all were negative, and none of the guinea-pigs became immune.

Entomology

76. The main mosquito vector, *Aedes africanus*, concerned in the transmission of yellow fever virus from monkey to monkey in the rain forest areas of Uganda is

not found in the drier areas of Kenya and Uganda and at present the vector concerned in transmission of the virus between bush babies is unknown. Many biting insects have been collected during the above-mentioned surveys and the material is now being examined.

77. *Biting habits of the mosquito Aedes simpsoni.* In Bwamba, Western Uganda, the requirements for the occurrence of human yellow fever are the presence of *A. simpsoni* in plantations close to forests containing infected monkeys. Monkeys raid the plantations and the mosquito carries the infection from them to man. These requirements are found in many parts of Uganda but human yellow fever is negligible. Experiments carried out in 1951 have shown that in many such areas *A. simpsoni*, although present, does not bite man. These non-biting mosquitoes appear to be confined to the higher altitudes and temperature may be one of the factors concerned. Further investigations are in progress and no generalizations can yet be made. The work has, however, one important practical implication. Before public funds are spent in attempted control of this mosquito in rural areas by repeated inspections and by removal of important food crops, a preliminary study should be made of the biting or non-biting habits of this mosquito.

78. *Rift Valley Fever Virus.* During 1951 a severe outbreak of this dangerous disease of sheep occurred in the Southern Free State of the Union of South Africa. A request was made by the Director of Veterinary Services, Onderstepoort, South Africa, for a special strain of the virus maintained at Entebbe. This was originally isolated by the Yellow Fever Research Institute, Entebbe, in 1944, from a batch of mosquitoes caught in the Semliki Forest—on the western side of the Ruwenzori range. By repeated passage through mice it was rendered safe for inoculation into lambs, and gave some promising results when used as a vaccine. A sample of the dried virus (eighty-third passage) was sent to South Africa, and it is understood that field experiments on its value as a vaccine are now in progress. This instance is a good illustration of how the results of a piece of research, of hitherto purely scientific interest, may suddenly become of considerable practical importance.

79. *Miscellaneous investigations.* These included investigations into a small outbreak of suspected encephalitis in Uganda in December, 1951; the occurrence of three fatal cases in Europeans from Kenya suspected to be poliomyelitis; an epidemic of an unknown fever at Lusaka, Northern Rhodesia; and an outbreak of jaundice in Malakal, Anglo-Egyptian Sudan.

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Scrub-Typhus

80. There has been a considerable amount of consolidation of work by the Scrub-typhus Research Unit in Malaya, and a number of publications are in preparation describing work which has been or is being rounded off. One officer (Mr. K. L. Cockings) left the unit in August, 1950, and Mr. Harrison was away for five months in 1951 on vacation leave in England. A total of 3,151 mammals and other hosts, and their parasites, were examined during the year, bringing the sum total up to 16,821. Fleas, parasitoid mites and ticks are being studied by Lt.-Col. Traub and his colleagues of the U.S. Army Research Unit. Lice are to be studied by Dr. Werneck (U.S.), endoparasites by Dr. Sandosham of the University of Malaya. Blood-parasites continue to be studied by the Malaria Division of the Institute, and pathological and histological material by the Pathology Division. To the routine collections in Malaya have been added collections from Sarawak (Mr. Tom Harrisson, Curator, Sarawak Museum), Hong Kong (Mr. J. D. Romer), Nicobar Islands (Dr. Gibson-Hill and Lt.-Col. F. E. Buckland), and North Borneo (Lt.-Col. Robert Traub and Dr. Audy). In July a contribution was made in funds and personnel to an American expedition to North Borneo led by Lt.-Col. Traub. Dr. Audy accompanied this expedition for part of the time. This opportunity to collaborate actively with the U.S. research team was greatly appreciated. The presence of the vector mite in considerable numbers has now been confirmed in Sarawak, North Borneo, Hong Kong, and the Nicobars.

81. The trap-mark-and-release experiments have been continued and extended, although particularly hampered by terrorist activities. Survival rates and ranges have been estimated for eight species of rat. The mean expectation of life for most species seems to be of the order of one and a half to two months, and the diameter of the home-range varies from about 50 metres for the little *Rattus exulans* to over 200 metres for the giant rats. Pregnancy-rates derived from the examination of rats trapped during the past four years have been correlated with rainfall, and it has been shown that in the forest species a dry month produces a high pregnancy-rate in the month following. Dominating this effect, however, is a marked bi-monthly rhythm which appears to be determined by the phases of the moon, in that conception is more frequent near the time of the full moon.

Taking the trombiculid mites as a sample, the parasite-patterns of different populations of rodents have been shown to throw light on the habits and habitats of the hosts. These studies are being extended and their application to problems of disease in man is showing promise. Taxonomic studies of Malaysian trombiculid

mites are being rounded off in collaboration with Mr. H. Womersley of the South Australian Museum, and by Lt.-Col. Traub. A total of at least 86 species have been encountered in the Malaysian collections so far. Of these, 49 species had not previously been described, and 26 now remain to be described. Ten of these species belong to the vector species group. The total number of known members of this group has risen from six in 1945 to over 24. A monograph on the vectors is being prepared in collaboration with Lt.-Col. Traub.

Pilot experiments on the transmission of rickettsial infections by the vectors, in collaboration with Dr. Savoor, have been discontinued owing to Dr. Savoor's retirement.

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82. The following summary (paras. 83 to 88) of the investigations made in Malaya during 1951 by the Scrub-Typhus Research Unit of the United States Army Medical and Graduate Research School, with its headquarters at the Institute for Medical Research, Kuala Lumpur, has been contributed by Dr. Joseph E. Smadel, who directs the Unit.

83. *Duration of immunity against scrub-typhus.* The results of studies in Malaya during 1951 indicated that the immunization of volunteers by the intradermal inoculation of small numbers of viable *Rickettsia tsutsugamushi* (the causative agent of scrub-typhus) followed by oral administration of specific antibiotic prophylactically produced a state of resistance to reinfection comparable to that attained in treated scrub-typhus patients. Furthermore, this state of resistance was attained without any clinical evidence of infection. Further tests demonstrated that solid immunity to reinfection with a homologous strain of rickettsiae persisted in most cases for as long as a year after initial vaccination. On the other hand, heterologous immunity was found to be quite evanescent; in the majority of persons solid resistance to reinfection with a heterologous strain of *R. tsutsugamushi* lasted only a month or so after vaccination, but partial resistance, as evidenced by the mildness of the clinical illness, lasted a somewhat longer period.

84. *Vaccination against scrub-typhus.* The Karp strain of *R. tsutsugamushi* employed in 1951 was found to be as suitable for the combined procedure of immunization with viable rickettsiae and specific chemoprophylaxis as was the Gilliam organism used in 1950. Furthermore, the most satisfactory chemoprophy-

lactic regimen found to date for adults weighing, on the average, approximately 100 pounds was as follows: 3.0 gram oral doses of chloramphenicol given every four days beginning on the seventh day after vaccination (DAV) and extending through the twenty-third DAV. It is likely that somewhat larger doses of antibiotic would be required for adult American males weighing 160 pounds. The optimal schedule would probably be 4.0 gram oral doses of chloramphenicol, given on the 7th, 11th, 15th, 19th and 23rd day after inoculation. Such dosages were well tolerated by Malay volunteers in 1949.

85. *Japanese encephalitis in Malaya.* While Japanese encephalitis was suspected to occur in south-east Asia, its presence had not been conclusively shown. During the fall of 1951, a mild central nervous system disease which occurred in race-horses in Malaya was tentatively identified by means of neutralization tests as Japanese encephalitis. With this lead, stored sera from volunteers in the scrub-typhus studies for 1948 and 1950 were tested and 32 of the 45 were found to contain significant levels of neutralizing antibodies against this virus. Finally, the agent of Japanese encephalitis was recovered from the brain tissue of a fatal case of central nervous system disease which developed in a European living near Kuala Lumpur. Such findings indicate that Japanese encephalitis has been present in Malaya for a number of years and that it caused clinical illness in horses and man in 1951.

86. *Leptospirosis as a military-medical problem in Malaya.* The experiences of two military patrols in Malaya, in which a 10 per cent. incidence of clinical leptospirosis was observed after jungle operations lasting for one month, emphasizes the fact that any military operations in the south-east Asia area must take into consideration the potential military-medical importance of this disease.

87. *The use of combined cortisone-chloramphenicol regimens in the treatment of typhoid fever and scrub-typhus.* This combined therapeutic regimen was applied to 17 typhoid fever and eight scrub-typhus patients with comparable results, i.e., the addition of cortisone to the established specific antibiotic treatment resulted in the disappearance of the acute toxic manifestation of the disease, including fever, in a matter of six to eight hours. In general, cortisone is regarded as of value in the supportive therapy of the seriously ill typhoid fever or scrub-typhus patient, but is no substitute for specific antibiotic therapy.

88. *The use of "Repellent, insect, clothing-treatment, M-1960" as a repellent for land leeches.* The field team sent to North Borneo observed that clothing impregnated with a standard U.S. Army Quartermaster issue item, the M-1960 repellent, exerted a strong repellent effect upon a Borneo land leech, *Haemadipsa zeylanica*, and prevented the attachment of this leech to the body. Plans for a more intensive evaluation of M-1960 as a leech repellent have been formulated and it is anticipated that they will be completed, with the assistance of the Institute, before 1st July, 1952.

Relapsing Fever

89. Dr. G. A. Walton, who has made a three-year field investigation of this disease in Kenya, was on leave in the United Kingdom for the greater part of the year; so that there is little field activity to report. A number of tests were made to discover the incidence of spirochaetal infection amongst adult *Ornithodoros moubata*. A total of 1,070 adult *O. moubata*, collected in the homes of Kenya natives, were inoculated into white rats in batches of ten, in an attempt to determine the spirochaetal infection-rate. Collation of the data revealed the percentage of infected ticks to be 0.78, the lower limit of probability being 0.38 and the upper limit 1.51.

90. Very interesting results have been obtained from the precipitin tests made

by Mr. Bernard Weitz, of the Lister Institute, on blood samples taken from the stomachs of ticks collected from many parts of Kenya. These results are given in the accompanying table. The ticks have been divided to include those from the high altitude districts of Meru, Embu, Nyeri and Teita into one group called " Highland Form ", and the remainder from Digo District on the coast called the " Coastal Form ".

Source of Blood Meal	Highland Form	Coastal Form
Man	59	8
Man plus Sheep or Goat	2	0
Sheep or Goat	1	1
Man plus Dog	1	0
Man plus Domestic Fowl	0	2
Domestic Fowl	1	113

91. From this table it will be seen that, despite the abundance of goats, sheep and cattle in nearly 60 per cent. of native dwellings in Kenya, no ticks had fed on cattle, and only 2.6 per cent. had fed on goats or sheep. On the other hand, while 91 per cent. of the " Coastal Form " had fed on domestic fowls, 97 per cent. of the " Highland Form " had fed on man, and this despite the more frequent occurrence of domestic fowls in native dwellings at high altitudes. This striking difference may be very significant. Since it is now known that the identity of the source of the blood meal of *Ornithodorus moubata* can be determined with great accuracy for well over a month after the feed is taken, this test will be much more frequently used in future investigations in parts of Tanganyika. There, it is understood, the tick is abundant in native dwellings in the absence of Relapsing Fever; and an attempt will be made to deduce definitely whether those variations in the behaviour of the tick so far observed are forced upon it by different environmental factors, or whether there exist a number of distinct forms of it within what is at present regarded as a monotype.

92. During the next three years it is the intention to extend this investigation of relapsing fever into Tanganyika. With this in view, the laboratory is being re-equipped, and the colonies of laboratory rats, rabbits and guinea-pigs, excellently maintained during Dr. Walton's absence by the Kenya Medical Department, are being extended. The full subordinate staff has been re-assembled. A Grade I laboratory assistant trained in medical entomology has been attached to the Unit by the Kenya Government. It is intended also to appoint a trained European Field Officer.

Preparation of Precipitin Sera

93. The investigation of precipitating antisera for the identification of blood meals of blood sucking arthropods was continued at the Lister Institute of Preventive Medicine, Elstree, Herts, by Mr. Bernard Weitz, M.R.C.V.S. The provision of sera of a wide variety of normal mammals, which forms the raw material of this work, was greatly improved in quality and quantity by the use of a mobile laboratory, especially constructed for this purpose and which arrived in East Africa early in 1951. Mr. W. A. Hilton, seconded to the scheme by the E.A.T.T.R.R.O., is in charge of the collection of sera; and blood and samples from 45 different animals, including 31 species of mammals, have been received at the Lister Institute during the year. The sera were then freeze-dried and kept for the preparation of antisera and for specificity tests. A wide variety of antisera were prepared in rabbits against various mammalian sera, e.g., Elephant, Rhinoceros, Monkeys, Porcupine, Mongoose, Hyaena and Hyrax, in addition to the sera of man and domestic animals. Antisera prepared in rabbits against sera from species of the family *Bovidae* gave non-specific results.

94. Experiments made at the Institute had shown that antisera with highly specific antibodies could be prepared by a " cross immunization " technique. This method involves the preparation of antisera in animals which are themselves closely related to the inoculated antigen. On the basis of these results an experiment was carried out by Mr. Weitz in Shinyanga by the courtesy of Dr. C. H. N. Jackson, Acting Chief Entomologist. Specific antisera were prepared in goats and sheep against the sera of Impala (*Aepyceros melampus*) and Reedbuck (*Redunca redunca*) and in calves against the serum of the African Buffalo (*Syncerus caffer*). These antisera gave no reaction with any other mammalian sera and are of great value in the accurate identification of blood meals and tsetse flies.

95. A further experiment by Mr. Weitz is in progress in Tanganyika involving the use of calves, sheep and goats, together with some African antelopes such as Thomson's gazelle, Dikdik, Duiker and Reedbuck, for the preparation of antisera in these animals against various bovids including Kudu, Eland, Bushbuck, Hartebeest, Klipspringer, Dikdik and Duiker. These antisera together with those already prepared in rabbits will cover the full range of possible hosts of tsetse flies from various parts of Africa.

Physiological Research at Makerere College, Uganda

96. Dr. Margaret Thompson, Dr. R. F. A. Dean, and Miss R. Schwartz, all financed by the Medical Research Council, have, as guest workers, had at their disposal both laboratory accommodation and equipment, and facilities in the Metabolic Ward. From time to time, as accommodation allows, patients on whom the Mulago Hospital staff require special investigation are admitted to the ward. Dr. Dean and Miss Schwartz are carrying out a thorough investigation of the biochemistry of Kwashiorkor, as seen in children. This has never before been systematically undertaken, and the results are of great interest. Dr. Margaret Thompson is also continuing her work on changes in digestive enzymes in this condition, and Dr. Dean is examining the effect of diets containing plant protein instead of milk. Several papers have been published or are in preparation.

97. *Serum proteins.* Professor E. G. Holmes and his staff have continued their investigation of serum proteins. The phase of the work mentioned in the 1950 report has now been published. Three salient features have emerged: (1) a correlation in the group studied (a random sample of adult African males) between red blood count and serum proteins, in the sense that serum albumin rises and total globulin falls with rising red blood count; (2) very high values throughout the series for " alpha " and " gamma " globulins, which remain relatively constant; and (3) a fall in " beta " globulin, with rising red cell count, which accounts for most of the fall in total globulin. It is of interest that a group of Makerere students have significantly lower erythrocyte-count and serum albumin values after three months' vacation in their homes than after six months at Makerere College. These observations must be regarded as preliminary in nature. Only conventional salting-out methods were available for protein fractionation, and the current literature shows that all these are suspect in the sense that it is uncertain what substances they really isolate.

98. Investigations are being continued on two further lines. Firstly, a micro-Tiselius apparatus is now available, and is being used for electro phoretic separation of proteins. Electrophoresis as a method of separation suffers from disadvantages, since the rate of movement of the protein fractions depends in this case on the mass, net change, and frictional properties of the molecules, giving no information about other chemical, still less biological properties. But it is extremely valuable as an adjunct to other methods. Progress with this technique has been slowed by the fact that the experiments have to be carried out at 15° C. or lower, which has

introduced an interesting, but tiresome complication. In this climate, there is severe water condensation at glass surfaces at 15° C., which puts the optical system of the apparatus out of action. The difficulty has finally been overcome by the construction of a rather elaborate perspex water-jacket, and by blowing a current of cooled, dried, air over the cuvette at intervals.

Secondly, to attack the problems presented, in particular by the high " gamma " and " alpha " fractions, it will be necessary to carry out fractionations on a semi-macro scale, by the Cohn technique, which avoids denaturation of the products. For this purpose a cold bath, capable of maintaining temperatures down to —20° C., has been constructed. Preliminary separations into Cohn's fractions II + III. IV — I & IV — 4 & VI have been carried out. Ordinary filtration, however, which is the only means of separation of the fractions at present available, is insufficient to give more than crude separation. The Rockefeller Foundation have, however, generously made a gift of a refrigerated centrifuge, which has already been shipped. Its arrival will permit further progress. It is felt that the field of serum proteins promises to be of great interest.

99. *Nitrogen balance experiments.* These have been mentioned in previous reports. The position now is that two patients who have been under investigation for more than a year continue to retain nitrogen on a high protein, high calorie diet, but show no increase in weight. The most rigid tests which we can apply, on our own initiative and on the advice of others, have so far failed to reveal any technical flaw which invalidates these findings. The position is quite remarkable, and can only, we feel, be explained on the grounds that the storage of protein is accompanied by simultaneous loss of water. Determinations of extra-cellular fluid volume show that a steady loss of water does in fact take place (the initial amounts of extra-cellular fluid in these protein-depleted subjects were very high indeed); but much more work on water balance will have to be done before a firm conclusion can be reached.

100. *Iron-balance experiments* are being made on patients with hookworm anaemia. The work has been somewhat slow owing to certain technical difficulties. A fact of some interest, namely, that the local water supplies are relatively rich in iron, has incidentally emerged; it may have a bearing on a fact already noted, namely, that the values for erythrocyte count, haemoglobin, and packed cell volume, in spite of providing evidence of anaemia in our sample of male Africans, show no prima facie evidence of iron deficiencies (see the second publication below, the substance of which was discussed in the 1950–1951 Report).

Publications

HOLMES, E. G., STANIER, M. W., SEMAMBO, Y. B., and JONES, E. R.—(1951) " An investigation of serum proteins of Africans in Uganda." *Trans. R. Soc. trop. Med. Hyg.*, **45**, 371.

HOLMES, E. G., GEE, F. L., and KYOBE, J.—(1951) " The blood counts of male Africans in and around Kampala." *E.A. Med. J.*, **28**, 298.

Hot Climate Physiology

101. During the year progress has been made at the Tropical Physiology Laboratory, Oshodi, Nigeria, in all the established lines of research, and the presence in the early part of the year of an additional physiologist, Mr. J. G. Fletcher, and of a visiting scientist, Dr. N. A. Barnicot, enabled the scope of the investigations to be widened. For some months therefore there were working in the Unit four qualified research workers, and two European technicians (Laboratory Superintendents), were also available for a short time, Mr. Chifney having been borrowed from the Nigerian Pathological Service. The laboratory accommodation had

been enlarged in anticipation of this number of workers. As in previous years there was both academic work carried out at Oshodi and field investigations elsewhere; these investigations are summarized separately below. Dr. Ladell, Senior Medical Research Officer directing the Unit, after a period of leave in the United Kingdom was lent by the Colonial Office to the War Office for special investigations in Korea.

102. The Unit continues to be the liaising body in West Africa for British Commonwealth Panel on Climate and Design of Buildings, forwarding information received from the Australian Commonwealth Building Research Station where Dr. Drysdale, the co-ordinator for the Panel, has his headquarters. In connection with this Panel Dr. Ladell attended an informal meeting held in London to " discuss co-operative research on some hot climate building problems," convened by the Colonial Liaison Officer at the Building Research Station of the Department of Industrial and Scientific Research. Dr. Ladell has also attended several meetings of the Medical Research Council's Climatic Physiology Committee, of which he is a corresponding member.

Academic Studies

103. *Estimation of the heat tolerance of normal Africans.* Using African subjects trained to the work, but not artificially acclimatized to severe heat, a linear relationship has been established between sweat-rate and Corrected Effective Temperature. With moderate wet-bulb temperatures the rectal temperature reached by a man working in the heat rises as the dry-bulb temperature increases; and is independent of the wet-bulb temperature; but with wet-bulb temperatures of 90° F. and higher the wet-bulb has more effect on the body temperature than the dry-bulb. Skin temperatures reached are dependent on the Corrected Effective Temperature, with an increase of approximately 1·5° F. for each 2° F. rise in C.E.T.

104. *Factors affecting the onset of sweating in Africans.* No direct relationship was demonstrable between skin temperature and rectal temperature at the onset of sweating, although, in general, sweating occurred at a relatively lower rectal temperature if the skin temperature was high and *vice versa.* There is some evidence that the skin temperature threshold for sweating can be influenced by the state of acclimatization and by the metabolic state of the subject.

105. *Effects of hot humid environments on the renal function of West Africans.* This work has demonstrated that rest in a hot humid environment can produce great alterations in the renal circulation, involving both a reduction in the renal blood-flow and in the rate of glomerular filtration. Exercise in these climates results in a further reduction in the blood-flow. The response of the West African to a diuretic water load has been investigated and significant differences shown between this response and that of Europeans in Europe.

106. *Indication of adrenal cortical activity during heat stress.* In a series of experiments carried out both on residentially acclimatized Europeans and on normal West Africans it was found that exposure to a hot humid climate, sufficient in some cases to cause collapse, does not result in changes indicative of A.C.T.H. activity. There was a fall, instead of the expected rise, in 17-ketosteroid excretion, the cause for which may be renal, while changes in the number of circulating eosinophils were difficult to interpret in view of apparent eosinophilia encountered in many subjects.

107. *The excretion of 17-ketosteroids in West Africans.* Dr. Barnicot confirmed his earlier finding that the ketosteroid excretion is lower in Africans than in Europeans, even though the European may be residentially acclimatized. The recovery of ketosteroid after the injection of testosterone is not significantly

different as between Africans and Europeans; the low excretion therefore is not due to defective liver function.

Metabolic studies. The investigation into the metabolic rate of certain every-day activities has been continued and extended to include tree-felling and log-cutting. A full report on the figures so far collected will be prepared for publication shortly.

Field Studies

108. *Physiological study of Gold Mining.* The Management of the Ashanti Gold Fields Corporation permitted an extensive investigation to be made in their deep mine at Obuasi, Gold Coast. Very severe conditions were found in some parts of the mine, and the men only avoid heat exhaustion, so it appeared from the observations made, by working at a slow rate and by taking full advantage of pauses imposed by such operations as blasting to get away into better ventilated drives or cross-cuts. The formal estimation of the heat tolerance of the mineworkers showed that the veteran underground workers had an acclimatization equivalent to that obtained by 21 days artificial acclimatization, which is approaching the theoretical maximum. Novice workers who had never previously been underground had the same acclimatization as the group of normal Africans tested at Oshodi. A diminution in the sweat response to a given stimulus, work in the heat, was observed after two or more hours rest in relatively mild climates during which gentle sweating had taken place; this phenomenon, apparently of adaptation, was subsequently confirmed by observations in the hot room at Oshodi. The Obuasi observations were particularly valuable as they serve as a check on the Hot Room observations outlined in para. 1 of the academic studies. They showed that the Oshodi results could be used to predict the performance of unacclimatized men under field conditions. Preliminary studies were also made at the plywood factory at Sapele and at a rubber plantation at Benin.

109. *Observations upon Albinism in West Africa.* Dr. Barnicot carried out observations on the genetics of albinism and red hair colour in Africans. The frequency of albinism appeared to be approximately 1/3,000 (European figure 1/20,000). Red hair is a graded character of approximate frequency 1/1,000, and appears to be inherited as a Mendelian recessive.

110. *West African blood groups.* Collections of blood and saliva for detailed blood group analysis were initiated by Dr. Barnicot and collections continued after his departure. Over 100 samples, collected at random, have already been despatched to the Lister Institute and to the Galton Laboratory, London. Material relating to the new " Henshaw " group has been collected.

111. *Observations in Korea.* These observations, while not made under the auspices of the Colonial Medical Research Committee, have been useful apart from their own intrinsic value in indicating the desirability of certain other lines of investigation to be carried out at Oshodi:—

(*a*) A series of blood-pressure readings, pulse-rate measurement and fitness tests, similar to the series done in Korea, are needed on British service men in Nigeria for purposes of comparison.

(*b*) The clinical observation that the incidence of cold-injury is apparently greater among men of African ancestry than among pure Caucasians suggests the desirability of investigations into cold-susceptibility of indigenous Africans.

Publications

LADELL, W. S. S.—(1951) " Changes in sweating after prickly heat." *Brit. med. J.*, **1**, 1358.—(1951) " Assessment of group acclimatization to heat and

humidity." *J. Physiol.*, **115**, 296.—(1952) "Rapid recovery of sweating in the arm after arterial occlusion." *Ibid.*, **115**, 69P.

FLETCHER, J. G.—(1951) "Some observations on skin temperature and the onset of sweating." Title only of oral communication. *J. Physiol.*, **116**, 10P.

BARNICOT, N. A.—(1951) "Urinary excretion of 17-ketosteroids under tropical conditions." Title only of oral communication. *Ibid.*, **116**, 10P.

East African Bureau of Research in Medicine and Hygiene

112. The Bureau, under its Director, Dr. K. A. T. Martin, has continued to play an important role in the sphere of medical research in East Africa, in effecting the co-ordination of the medical group of research schemes administered by the East Africa High Commission with one another, with the territorial medical departments in East Africa and adjacent territories, with the Colonial Medical Research Committee in London, and with the numerous scientists who have visited those territories. In pursuance of those functions Dr. Martin visited the United Kingdom in October for discussions of a general nature with the Committee and with the Research Department of the Colonial Office, and, in particular, for discussions concerning the Colonial Research Service and the research plans of the East Africa Malaria Unit.

113. These liaison and consultative functions have recently been extended by the inception of the East African Standing Advisory Committee for Medical Research by which the opportunities and priorities for medical research in East Africa will from time to time be reviewed for reference to the Secretary of State and his appropriate Advisory Committees. Its inaugural meeting was held in March, 1952, in Nairobi. The Director of the Bureau has been appointed Secretary to this East African Committee. His intimate knowledge of the several research units greatly assisted the two members of the Colonial Medical Research Committee who attended the inaugural meeting as delegates, and later visited the research units.

Leprosy

Malaya

114. Dr. F. S. Airey has continued his research on leprosy at the Sungei Buloh Settlement, Selangor, including therapeutic trials with thiosemicarbazones.

A test group of patients was started on TB-1 (p-acetylaminobenzaldehyde thiosemicarbazone) in 1950. Early impressions have been justified. It is effective, particularly in lepromatous leprosy, though unlikely to challenge sulphone. Toxicity is slight, characteristically amounting to transient albuminuria and occasional conjunctivitis, though one death (acute liver atrophy) and a few cases of jaundice aroused suspicion in 1950, which subsequent experience has not confirmed. The pilot group was small, so conclusions are tentative. There is no qualitative difference between thiacetazone-treated and sulphone-treated cases. Bacteriological change is comparable, but the count is less reliable than morphological alteration. Dosage has now been reduced to a single tablet of 50 mgm. each day, and it is believed this may suffice. Lepra reaction is not favoured by the drug, nor is the tendency for it to occur lessened. Thiacetazone is excreted rapidly as Dr. I. A. Simpson (Acting Senior Biochemist at the Institute for Medical Research, Kuala Lumpur) has demonstrated. He has devised a test for estimating the substance in plasma and urine, and when assay methods have been perfected the behaviour of other drugs in this group will be assessed.

115. Bacteriologists have noticed morphological variation in untreated leprosy; the fragmented, non-bacillary, non-acid-fast and filterable forms have

been seen independently of chemotherapy. The change in form which occurs soon after starting treatment with sulphone and thiacetazone, suggesting impending disintegration of the organism, might be interpreted as a measure of the drug's beneficial effect. Continuous attention has been given to this matter, the study of which has been facilitated by fluorescence microscopy. There appears to be little doubt that these altered forms may regenerate and that the "fragmentation" seen is no more than reversion to a more primitive stage in the life-cycle of *M. leprae*. The drug, it is presumed, has a bacteriostatic effect, leading to change in character without necessarily alteration in viability.

116. Clinical trials with TB-3 (p-ethylsulphonylbenzaldehyde thiosemicarbazone), which have been in progress for a year, reveal bacteriological and clinical changes which are in all ways comparable with the use of TB-1. Though transient albuminuria is accepted as a possible sequel, alarm was caused by the need for tracheotomy in one girl—a severe lepromatous case in reaction, where the disease involved the upper respiratory passages.

Though aware of the value of synergism, caution is being exercised; for, in place of additive and synergistic influences, combinations of antimicrobial agents may actually have an antagonistic effect. It is tempting to combine substances such as thiacetazone and sulphone, in the hope that one may enhance the effect of the other; but it may prove best to change the remedy at an appropriate stage. Notice has been taken of the warning that, in vivo at least, a chemotherapeutic agent of known efficacy may be impeded by the coincident use of another to which the organism is only moderately sensitive.

117. The equipment of the research laboratory at Sungei Buloh Settlement, established in 1950, is now complete, lacking only staff of technician grade to make possible detailed fundamental investigations. Recruiting for an isolated settlement in Malaya under prevailing circumstances is understandably difficult. Histopathological studies in particular have been embarrassed by this shortcoming; but, as a temporary measure, the Institute for Medical Research has undertaken routine processing, with Dr. A. T. H. Marsden (Acting Senior Pathologist) frequently advising. Sponsored by The British Empire Leprosy Relief Association, a secretary (Miss M. E. Peters) arrived in November, 1951, to take over the clerical work.

Nigeria

118. Although the Committee has not been directly concerned with leprosy research in Nigeria, which is financed locally, it will be suitable to include here the report by Dr. John Lowe, Research Officer at the Uzuakoli Leprosy Settlement, on the work done during the year.

119. In last year's report, the work done up to February, 1951, was summarized, the main object being the establishment of sulphone treatment of leprosy on a sound, safe, and rational basis, and in a form capable of wide application. This, it is believed, has been attained by the use of D.A.D.P.S. given orally twice weekly, or even once weekly. This treatment is now being used in over 20,000 patients in Nigeria. Other sulphones have no advantages, and many disadvantages.

120. *Further studies of the pharmacology and mode of action of sulphones.* The work had been based on the hypothesis that the sulphones previously used (which were complex disubstituted sulphones) act mainly, if not entirely, by liberating D.A.D.P.S. in the body; experiments in animals had supported this view, but there had been no direct experimental evidence in human beings. The recent work had aimed at providing this proof. By special but quite simple methods it was found possible to separate D.A.D.P.S. from the blood of patients receiving complex sulphones, and to estimate its concentration. Studies were made in patients

receiving Sulphetrone, Diasone and Promin, by mouth or by injection, in the usual doses. After oral administration, acid hydrolysis in the stomach produced much D.A.D.P.S., which was absorbed and produced blood-levels well above the minimum therapeutic blood-level. After injections the blood D.A.D.P.S. levels were low, at about the lowest limit for therapeutic activity, since little hydrolysis occurred in the body. Actually the blood-levels observed after injections were little higher than could be explained by the D.A.D.P.S. present in the original complex sulphone as an impurity, or produced during the preparation, sterilization and storage of the solution to be injected.

121. Studies of the minimum therapeutic dose and blood-levels of D.A.D.P.S. have been made. A dose of 50 mg. a day is found therapeutically active, and a blood-level of 0.2 mg. per cent. Doses and blood-levels fifty per cent. lower than this show some activity. For full effects, higher doses and blood-levels are preferred, and twice-weekly treatment is as good as, and safer than, daily treatment. The efficacy and safety of twice-weekly doses rising slowly from 100 mg. to 400 mg. have been amply confirmed; many of our patients have completed well over three years' treatment on this regime.

Studies of the metabolism and excretion of D.A.D.P.S. have been made with new findings of some interest.

This whole subject has been thoroughly discussed in a paper (1952 a).

122. *Studies of other chemotherapeutic agents.* Some, including streptomycin, and PAS, were discussed in the previous report. A thiosemicarbazone (para-acetamidobenzaldehyde thiosemicarbazone, or TB1/698) had given promising results, and has been under test here for eighteen months in patients now numbering 150. The dose has been 150 mg. a day. Apart from one case of acute agranulocytosis, serious toxic effects have not been seen. The complications have been rather fewer than with sulphone, and no serious allergy has arisen. Clinical and bacteriological improvement has been about the same as with sulphone. This therapeutic agent provides a very useful alternative treatment to sulphone, particularly for patients who become allergic to sulphone or who develop severe or frequent " reactions " on sulphone treatment. Because it is more troublesome to give (twice daily instead of twice weekly) and is more costly, it is not likely to replace D.A.D.P.S. treatment. An account of these studies has been published (1952 b).

123. *Studies of the use of ACTH and cortisone in leprosy.* Knowledge of leprosy and its complications (" reaction," acute neuritis, acute eye inflammation, etc.), and of ACTH and cortisone and their mode of action in other diseases, suggests that these hormones might relieve the acute symptoms of leprosy, which can be very troublesome; but they are not likely to benefit the leprosy itself, and might even aggravate it by diminishing or abolishing the tissue reaction which keeps the disease in check. If these expectations are fulfilled, the question arises whether by careful regulation of dose, and by continued or intensified chemotherapy given at the same time, it might be possible to secure the good effects of hormone treatment and avoid the bad ones.

124. Trials of ACTH and cortisone, provided by the Medical Research Council, in the acute and sub-acute complications of leprosy have been carried out here. Thirty-eight such cases have been treated and studied during a period of four months. In all cases, the immediate response to treatment has been excellent. Severe " reaction ", acute neuritis, and severe eye inflammation have been relieved within a day or two. The cessation of treatment has however been far too often followed by a recurrence of the symptons, and also by the development of other complications, and further treatment has given only temporary relief, followed by

complications becoming more severe and more frequent, and definitely indicating an aggravation of the leprosy. All attempts by modification of dosage to prevent this deterioration have failed, and the conclusion is that in general the use of these hormones is contra-indicated in leprosy.

There are however two ways in which these hormones are of great value in leprosy. In sulphone sensitization, with drug fever, dermatitis, hepatitis, etc., which may be so severe as to endanger life, a three-day course of ACTH or cortisone is enough to set the patient well on the way to recovery although occasionally a second course is needed; in leprous eye inflammation, the local use of cortisone in the form of eye drops appears to be of great value, in preventing serious damage and possibly blindness. Neither of these procedures has been followed by an exacerbation of the leprous process. A report is in preparation.

125. In addition to the continuation of the above studies, the following investigations are now in progress or are planned for the immediate future:

(1) *Studies on the use of new chemotherapeutic agents.* These include an isopurine, (M7438 of I.C.I.), and a phenazine dye (B283) originally isolated from a lichen and since synthesized (Barry).

(2) *Studies of immunity in leprosy and cross-immunity with tuberculosis.* Healthy persons and persons with leprosy are lepromin-tested and tuberculin-tested; persons negative in both tests are to be immunized with BCG, and the effect of this immunization on the results of the two tests is to be studied. Clinical studies bearing on this subject are planned; in persons suffering from both leprosy and tuberculosis, the form and the progress of the leprosy and the tuberculosis, and the results of lepromin and tuberculin tests are to be studied.

(3) *Studies of abnormal laboratory findings in leprosy, and of the effect of chemotherapy on them.* Such findings include positive Kahn tests, abnormal blood-protein levels with reversal of albumin-globulin ratios, high erythrocyte sedimentation rates, and other abnormalities. This work has been in progress for nine months, and the results are now to be analysed.

Publications

LOWE, J.—(1951) " Sundry experiences in the chemotherapy of leprosy ". *Internat. J. Leprosy*, **91**, 14—(1952 a) " Studies in sulphone therapy (1) The mode of action of sulphones. (2) The use of D.A.D.P.S." *Leprosy Rev.*, **1**—(1952 b) " Para-acetamidobenzaldehyde thiosemicarbazone in the treatment of leprosy ". *Lancet*, **1**, 436.

Idem and DAVEY, T. F.—(1951) " Four years' experience of sulphone treatment of leprosy ". *Trans. R. Soc. Trop. Med. Hyg.*, **44**, 635.

Goitre

Investigation in Nigeria

126. Dr. Dagmar Wilson undertook an initial enquiry of three months' duration into the incidence of endemic goitre in the Central Plateau region of Northern Nigeria. Amongst various aspects to be investigated are its relation to the state of nutrition and to intercurrent disease, and the efficacy of iodised salt. This malady has been increasingly recognised of late in many different aboriginal tribes of Africa. An outline of the proposed investigation was considered by the Committee; and, as a token of its interest in them, a small grant towards the cost of the enquiry was recommended, and made from the research funds provided by the Colonial Development and Welfare Acts.

127. The area investigated covers 700 square miles, at an altitude of 4,000 feet. In its commercial centres, rapid industrialisation has led to extensive immigration from other parts of Nigeria; outside these centres the agricultural lands remain inhabited by local " pagans ". Observations were made in hospitals, dispensaries, schools, communal gatherings and in the home, amongst the Berom, Inegwe, Hill Jarawar, Jere, Rebinawa, Rukaba and Moslem Fulani peoples. The association described in French West Africa between the distribution of endemic goitre and the use of " vegetable salt " prompted enquiry into the provision of salt and the composition of indigenous salt substitutes. Geological aspects were considered with the aid of Mr. W. N. Macleod, of the Geological Survey of Nigeria. Reported areas of obvious goitre were found mostly to lie on the granites, or to be associated with drainage areas off granites.

128. Goitre endemicity was generally low amongst the pagans. In about 5 per cent. of adolescent women the thyroid at rest was somewhat enlarged, soft, smooth and symmetrical. But in certain well-defined areas it was common amongst the women, though uncommon amongst the men; the enlargement being irregular, and nodular or cystic. Amongst those who had resided from birth on small areas of the Plateau covered by basaltic Larval flows of Tertiary and Recent Age, it was absent. In the leper settlements goitre was marked amongst those who had come from goitrous areas.

129. Indigenous sources of salt in Nigeria have never sufficed, and salt has long been imported, mostly from the territories to the north; small quantities of marine salt are produced in the coastal areas. At the present time British salt is being increasingly imported, principally for use in and around the towns. The more remote peoples depend largely on " vegetable salt ", made from the burnt stalks of cereals, millets or guinea-corn, or from wood ash; where the ground is barren, goat or donkey dung is burnt and used by the poor as a salt. Five samples of Nigerian salts were examined by Professor Murray at Bedford College, London. She reported that only one sample, that from the Benue, contained an appreciable amount of sodium chloride. Two samples from Bornu (red and white), and one sample from Sokotor consisted mostly of sodium sulphate and sodium carbonate. A sample of " vegetable salt " prepared on the Central Plateau by Birom pagans from the stalks of a locally grown millet, *Pennisetum spicatum*, consisted mainly of pot ashes with only traces of sodium.

130. Accepting the generally held view that simple goitre and other pathological conditions associated with low iodine intake are most effectively prevented by the prophylactic use of iodised salt, certain Local Authorities in Northern Nigeria are importing this commodity.

Nutrition

Field Research Station, Fajara, The Gambia

131. Investigations have continued into nutritional disorders and into infections, particularly with malarial parasites, which contribute to many common manifestations of ill health. The general problem as seen in the Gambia has features in common with that in other colonial territories and many other tropical areas. The research workers resident at Fajara for some part of the period under review include Drs. O. Lindan, and J. Done and Miss H. M. Dewey from the Medical Research Council's Human Nutrition Research Unit, Drs. Rosemary Jackson, I. A. McGregor and J. McFadzean of the staff of the Field Research Station and Dr. Dean A. Smith, Senior Lecturer in the Department of Human Nutrition at the London School of Hygiene and Tropical Medicine. The contingent from the Human Nutrition Research Unit is the largest yet stationed at Fajara for any length of time, evidence of the satisfactory state of the research facilities which have been

built up there. The work reported has been directed by Professor B. S. Platt, who was at Fajara from October, 1951, to April, 1952.

132. A notable feature of the metabolism of Gambian children, which had been reported previously, is the low output of nitrogen in the urine. In the normal urine the proportion of total nitrogen excreted as urea is about 85 per cent.; in the urines of Gambian children as little as 25 per cent. of the total nitrogen may be present as urea—even in experimental starvation values as low as this have rarely been obtained. Low levels, usually 50–60 per cent. may persist in the Gambian children for many weeks in spite of improvement in the diet and control of malarial infection. Occasionally dramatic changes in the proportion of urea nitrogen may follow the addition of milk to the diet (skimmed milk powder is preferable to whole milk) or the administration of a mixture of vitamins of the B-complex. These effects are not however invariable, and the reasons for the differences in the response are not yet known.

133. Investigations of nitrogen balance involving several days' accurate observations of food intake and analysis of carefully collected excreta have been slow and tedious. Recently, however, the labour involved in one aspect of these studies has been greatly reduced by the development of a new technique with which it has been found that only about half the nitrogen in the daily diet is absorbed from the alimentary canal; on an apparently good or even excellent diet the loss of nitrogen in the faeces is so great that the consumer is in effect subsisting on a low protein supply to his body tissues. The explanation of these observations no doubt lies in the failure of the pancreas to secrete proteolytic enzymes in more than small amounts. The lipase and amylase content of the pancreatic secretion is also no doubt low since impairment of fat and carbohydrate digestion has been recognised for some time as a feature of our cases. The initial lesion is probably therefore caused by an inadequate supply of nutrients, especially protein, for the synthesis of pancreatic enzymes. Definite evidence of a substantial reduction in the amount of trypsin, lipase and amylase in the pancreatic juices of malnourished infants and children has been obtained by Dr. Margaret Thompson in Uganda.

134. Recently, during the examination by paper chromatography of amino acids in urines from Gambian infants and children, a " spot " not due to any known alpha-amino acid was frequently observed. It proved to be due to the recently identified beta-amino-isobutyric acid (alpha-methyl beta-alanine). In urines from nearly 500 people examined at University College Hospital, Dent and his co-workers found originally that less than 5 per cent. contained any considerable quantities of this substance. In over 600 Gambians ranging in age from 90 years to a few weeks the new substance was present as follows : in 25 per cent. it was seen in greater amounts than any other amino acid, and in 20 per cent. it was found in moderate amounts. Many of the urines examined were from family groups selected with a view to examining the possibility of a genetic factor. Recent observations in the United States indicate the possibility of a connection between the occurrence of beta-amino-isobutyric acid and the existence of neoplastic disease and in the experimental animal with the metabolism of desoxyribonucleic acid. Drs. Lindan and Done are continuing with the study of this substance. Dr. Done is also investigating the behaviour in the body of gamma-methylene glutamine which he recently discovered in the vegetative parts of the groundnut plant.

135. The red pigment of "kwashiorkor" hair has been extracted and it has been found that the black pigment of normal African hair can readily be converted to a red one. The mechanism by which the change from normal to red or tan colour occurs is being investigated in experimental animals.

136. The work on the handling and assay of tritium which is being done at the Human Nutrition Research Unit has now reached the stage at which this isotope

is being used in experimental animals in a study of the synthesis of pancreatic enzymes and of proteins in milk; in the latter particular attention is being paid to those in the whey fraction in view of the observations already made in the Unit on the difference in behaviour in the stomach of these proteins compared with casein. These studies are regarded as preliminary to the application at the Field Research Station of isotope techniques to similar problems in humans.

137. Feeding experiments on growing rats with diets made up from Gambian foods have revealed various defects, including delayed growth; the addition of casein or lysine markedly improves the growth rate. Dr. B. Balfour, who has been making these experiments at the Human Nutrition Research Unit, has found histological changes in the livers of the animals on the Gambian diet similar to those found in protein deficient animals. Changes in the thyroid glands of these animals are of special interest—other tissues are still being examined. The staff of the Government Chemist, who are kindly making analyses for various nutrients, are assisting in these studies of the Gambian diet. Miss J. C. Chettle, who worked at the Field Research Station last year, has also been engaged in making these feeding experiments; she has recently been transferred to the staff of the Applied Nutrition Unit at the London School of Hygiene and Tropical Medicine.

138. Work on food technology has been resumed, with the appointment of Dr. F. E. Byron to the Applied Nutrition Unit at the London School of Hygiene and Tropical Medicine. Dr. R. A. Webb, formerly a member of the staff of the Human Nutrition Research Unit, is now working on the Station at Fajara under the auspices of the Agricultural Research Council. He is continuing work on the chemical composition of plants in relation to the soil.

139. It is recognised that malarial infections are universal and repeated in young children in the Gambia. These children are also almost entirely breast-fed for the first one and a half years of life and usually obtain only small amounts of milk from the mother after the first six months. Some signs of malnutrition occur early in life—dyspigmentation of the skin and hair, for example, are common after six months of age in infants who are still at the breast. Present evidence does not permit an assessment of the extent to which malarial infections, particularly chronic ones contracted early in life, affect the nutrient requirements and the state of nutrition of growing infants. Dr. Jackson is investigating a method by which the proteins of sera produced in response to malarial infection may be assayed. At the same time a study is being made of the alterations caused by infections in haemoglobin production and red cell formation. Observations on anaemias investigated during the past five years have been analyzed in connection with this work. Bone-marrow examinations are being made as part of this study of anaemia and also as a preliminary study of an easily obtainable actively growing test tissue which may reveal metabolic defects.

140. Work on liver pathology is being done on experimental animals, particularly in continuation of the work done by Drs. Waterlow and Walters which is now being prepared for publication. In addition to this, more observations on the impairment of liver function as judged by the ability of the body to effect conjugation of sulphonamides and of benzoic acid are being made. Evidence of gross impairment is not common; restoration of normal function as judged by these biochemical tests is quite rapid; the numbers of examples of deranged function have been too small for a satisfactory study. It is not yet clear whether what has been called hepatomegaly is in fact always a true enlargement of the liver, and it seems that some investigation of the actual size of the liver by other means than palpation must be made before continuing further arguments as to the causation of " hepatomegaly ".

141. An experiment in the control of malaria in a village area with a view to determining the effect of the infection on the state of nutrition and on general health has continued in the village of Keneba. After a year during which the number of mosquitoes was reduced by spraying, Dr. McGregor and Dr. Dean Smith have recorded several changes; the amount of haemoglobin in the blood of all ages has increased, the incidence of conjunctivitis has fallen and there has been a decline in the incidence of deficiency signs affecting the eyes, mouth and skin. The fall in weight associated with the hungry season, which at Geneiri in 1950 was over ten per cent., was at Keneba in 1951 less than four per cent. in males and non-pregnant females. In addition to control of the mosquito population the villagers at Keneba have been given a single dose of chloroquine; and measures have been taken to control bancroftian filariasis by the administration of hetrazan, and hookworm by the administration of tetrachlorethylene. Observations are being made continuously on the mosquito density in huts in order to determine the effect of the residual insecticide (Gammexane). Observations for purposes of comparison are being made in neighbouring villages on mosquito population, parasitization and state of health of the inhabitants. Mr. D. P. Gamble, a Colonial Research Fellow working in the Gambia, has helped substantially with the work at Keneba and in the neighbouring villages; the association has also been of benefit to him.

142. Observations on infants delivered by a trained African midwife have been continued since 1949 in villages within 20 miles of Fajara. Nearly 400 infants had been seen up to the end of 1951; of the 333 remaining in the area under observation 69 have died. Several of the older children have been investigated in the ward as " normals ".

143. The mortality from malaria in the research ward in the past two years seems to have been less than in previous years; this reduction has followed the introduction by Professor Platt of the treatment of malaria by small doses of chloroquine repeated only when necessary as judged from the clinical condition and the level of parasites in the blood. The effect of small doses of chloroquine persists sufficiently long for small weekly doses to be given prophylactically to control infection; for many months alternate new infants in the series mentioned above have been given chloroquine since birth with striking effect on the general condition. The remaining infants in the series have had no chloroquine and have been less well, or, in many cases, have already died. A similar series has been started in the control villages near Keneba. A trial has been made of the new drug 2:4-diamino-5-p-chlorophenyl-6-ethylpyrimidine (compound number 50-63) now known as Daraprim; this also promises to be of value in controlling malarial infection in infants and young children.

During the period under review nearly 200 patients have been admitted to the ward at Fajara. The majority of them have been cases of malaria and malnutrition.

144. Dr. McFadzean has been investigating for Dr. Hawking the effects of a new trivalent arsenic compound on filariasis and the effects of ACTH and Cortisone on elephantiasis due to *W. bancrofti*. He has also continued work, begun at the National Institute for Medical Research, on the relationship between the periodicity of the occurrence of microfilariae in the peripheral blood and the amount of oxygen in the inspired air and on the diurnal changes in urinary and blood constituents. Surveys have also been made on the infestation rates by *W. bancrofti* in typical inland, swamp and coastal villages.

145. In April of the year under review Professor Platt attended at the invitation of the World Health Organization the second meeting of the Joint Expert Committee on Nutrition held with the Food and Agriculture Organization of the United Nations. Many of the subjects considered were of immediate relevance to the various branches

of the work on nutrition problems in colonial territories. One of the main features of the meeting was the presentation of the report on kwashiorkor by Professor J. F. Brock and Dr. M. Autret who had visited Fajara in December, 1950, to discuss this problem. Preparations have begun for the conferences on " Malnutrition in African mothers, infants and young children " to be held consecutively at Fajara in the autumn by the Commission for Technical Co-operation in Africa South of the Sahara and by the World Health Organization and Food and Agriculture Organization jointly. It is expected that by this time at least 12 research workers will be on the Station, half of them being concerned with subjects other than nutrition. A proposal is under consideration for the holding at Fajara of a nutrition school for colonial officers similar to that held in Uganda in 1949.

146. The valuable assistance given by nurses from the staff of the National Hospital, Queen Square, has been continued by arrangement with the Management Committee. The co-operation of the members of the staff of the various Gambia Government Departments has continued; collaboration with the Medical Department has been most satisfactory and productive. Much of what has been done has been possible only because of the goodwill of the Gambian people, particularly of the senior Africans in the villages in which we have worked.

A list is attached of publications not previously mentioned in these reports; it includes work by members of the staff of the Human Nutrition Research Unit and of the Department of Nutrition at the London School of Hygiene and Tropical Medicine. The Reports of the London School of Hygiene and Tropical Medicine give more detailed accounts of the work and contain fuller lists of publications.

Publications

BASSIR, O.—(1951) " The importance in nutrition of the amounts of phosphorus in poor dietaries." Ph.D. Thesis, London.

BORROW, A. and PENNEY, J. R.—(1951) " Further observations on biological reactions by the Cartesian diver technique—with special reference to mammalian tissues." *Exper. Cell. Res.*, **2**, 188.

CAMPBELL, I. G., WHITE, D. F., and PAYNE, P. R.—(1951) " The uptake of tritium-labelled water vapour by the mammalian lung." *Brit. J. Radiol*, **24**, 682.

DONE, J.—(1951) " A new metabolite (an amino acid amide) in the groundnut plant (Arachis hypogaea)." Ph.D. thesis, London.

Idem and FOWDEN, L.—(1951) " A third amino acid amide in peanut plants (Arachis hypogaea)." *Biochem. J.*, **49**, 20.

FOWDEN, L.—(1951) " Quantitative recovery and colorimetric estimation of amino acid separated by paper chromatography." *Ibid.*, **48**, 327.

MCGREGOR, I. A. and SMITH, DEAN A.—(1952) " Daraprim in the treatment of malaria—a study of its effects in falciparum and quartan infections in West Africa." *Brit. med. J.*, **1**, 730.

PAYNE, P. R., CAMPBELL, I. G., and WHITE, D. F.—(1952) " The combustion of tritium-labelled organic compounds." *Biochem. J.*, **50**, 500.

PLATT, B. S. and BORROW, A.—(1951) " Behaviour of food in the rat's stomach." *J. Physiol.*, **112**, 51P.

SMITH, DEAN A.—(1952) " The African child." Opening paper in discussion. *Trans. Roy. Soc. trop. Med. Hyg.*, **46**, 41.

Idem and WOODRUFF, M.—(1951) " Deficiency diseases in Japanese prison camps." *MRC Special Report, No.* 274.

WALTERS, J. H. and SMITH, DEAN A.—(1952) "Oedematous beri-beri in Gambian palm wine tappers." *W. African Med. J.* (*New Series*), **1**, 1.

The following duplicated memoranda are available from the Applied Nutrition Unit at the London School of Hygiene and Tropical Medicine:—

GRANT, M. W. and GRIFFITHS, J. "Draft report on nutrition surveys at Yoroberikunda, Gambia, 1945–1946."

SMITH, DEAN A. "Technique for the clinical section of a nutrition survey."

GRANT, M. W. "Technique for the analysis of height and weight in tropical areas."

RESEARCH WORK UNDERTAKEN AND FINANCED BY THE MEDICAL DEPARTMENTS OF COLONIAL TERRITORIES

147. 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

148. 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 financed from Colonial Development and Welfare funds) have been given in their appropriate context earlier in this Report. Other investigations noted by Dr. Field are as follows:—

Nutrition

149. Studies on rice suggest that soil and growth conditions affect the nutritive value more than does the variety or strain. Attempts to produce a parboiled rice which, while retaining its nutrients, would be acceptable in colour and taste to peoples who normally eat white rice have met with some success: the flavour and smell of the parboiled grain have been improved without loss of thiamin, but the yellow colour has so far resisted the action of harmless bleaching agents. The cooking qualities of rice, too, are being studied. Some varieties yield non-glutinous grains; others, like "Pulut" rice, become soft and sticky. On the analogy of the "hard" and "soft" wheats the differences may be related to the amino-acid pattern of the grain, an assumption which is being studied by chromatographic methods.

An anaemia survey among Malays, Indians, Chinese and aborigines is nearly complete. The degree of anaemia seems to be broadly related to the dietary pattern of the groups, with iron deficiency as the usual cause.

Bacteriology

150. The search for antibiotic-producing moulds and bacteria from Malayan soils continues. Promising strains have been sent for further examination to the antibiotic plant established near Bristol by the Medical Research Council.

Pathology

151. The agglutination-inhibition test for the diagnosis of small-pox has been further developed: continued work on haemagglutination in tuberculosis and

leprosy suggests that *M. tuberculosis* and *M. leprae* have two common antigens in their mosaic. Complement-fixation tests on some five hundred sera of human and animal origin suggest that Q fever is not uncommon in Malaya.

The United States Army Scrub-Typhus Research Unit

152. A fourth Unit from the Virus and Rickettsial Diseases Division of the United States Army Medical Department Research and Graduate School, Washington, was attached to the Institute during part of the year, and continued the earlier studies of immunity problems in scrub-typhus, and extended the trials of chloramphenicol-cortisone in typhoid fever. An expedition to Mount Kinabalu in North Borneo in August yielded useful collections of mammals and their ectoparasites. (For a more detailed summary, see paragraph 82.)

Kenya

153. In the Division of Insect-Borne Diseases of the Kenya Medical Department, Dr. R. B. Heisch and his collaborators have made a number of investigations that have included studies on the bionomics of *Ornithodoros graingeri* n. sp. on the new haemosporidian of insectivorous bats, on piroplasms from a genet cat and squirrel, on blood-meals in "wild-caught" mosquitoes, ticks and other arthropods, and on new species of culicines. In relation to onchocerciasis Mr. McMahon has studied the distribution of *Simulium neavei* and its control by DDT emulsions, and has described several new species of Simuliids. A survey of dental fluorosis in school children has been made by Dr. Nevill. In the field of relapsing fever, studies have been made of the treatment of the infection by chloramphenicol, the development of *S. duttoni* in lice, and the control of *O. moubata* with different formulations of gammexane. Other investigations have included certain aspects of schistosomiasis, trypanosomiasis, silicosis, tuberculosis, and psychotic states.

Fiji

154. The Medical Department reports that the survey on filariasis has continued during the year, special attention being paid to comparing the incidence of microfilaria in the blood of inhabitants in villages which have been subject to grass cutting and bush clearance within the vicinity of these villages during the past five years. This project is a long term undertaking and will not be completed for at least another three years. Early indications, however, suggest that the prevalence of *Aedes scutellaris pseudo-scutellaris*, the mosquito vector of filariasis in Fiji, is being sufficiently reduced to reflect a lower incidence of microfilaria in the blood of the lower age groups. A definite statement in this respect will not be justified until the second survey at a five year interval is completed.

Jamaica

155. From the Faculty of Medicine of the University College of the West Indies it is reported that research work in progress covers a variety of subjects that includes a survey of diet and malnutrition in Jamaica, the metabolism of vitamin B 12 in normal and under-nourished children (in collaboration with the University of Pennsylvania), peptidase activity in human tissues, field studies of liver disease in infants, and the use of penicillin, aureomycin, chloromycetin and terramycin in the treatment of *Framboesia*.

Singapore

156. The Departmental Reports of the University of Malaya record that a considerable amount of research has proceeded throughout the year. In the Department of Biochemistry work has been directed primarily on the nutrient value of local foods, and toward the minimising of losses of nutrients in the course

of their preparation. In the Medical Faculty investigation has been largely concentrated on clinical conditions of local interest, such as the anaemias, rheumatic fever, liver disease, the treatment of typhoid fever with chloromycetin, and cases admitted in coma. The Department of Parasitology is investigating the helminths of small mammals and marine fish, the former in collaboration with the Colonial Office Scrub-typhus Research Unit at the Institute for Medical Research, Kuala Lumpur. In the Department of Physiology studies have continued on the physiology of sweat-secretion and on haematology; the former in collaboration with the joint Medical Research Council—Royal Navy Tropical Research Unit in Singapore. As a field activity of the Department of Social Medicine, important observations were made of the incidence of filariasis and goitre amongst the aboriginal tribes of the Malayan hinterland by Dr. I. V. Polunin. Dietary studies are also proceeding.

Committee for Colonial Agricultural, Animal Health and Forestry Research Seventh Annual Report (1951-1952)

Ministry of Food,
Dean Bradley House,
Horseferry Road,
London, S.W.1.
17*th July*, 1952

SIR,

I have the honour, on behalf of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to transmit to you the Seventh Annual Report of the Committee covering the period 1st April, 1951, to 31st March, 1952.

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., 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 Station, Cambridge University.

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., 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., Principal and Vice-Chancellor, Birmingham University.

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.

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

SEVENTH ANNUAL REPORT

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COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

SEVENTH ANNUAL REPORT

I. GENERAL

The Committee wish to place on record their appreciation of the services rendered by Sir William Ogg, Sir John Simonsen and Dr. Cheesman, who retired during the year under review. Dr. E. M. Crowther, Head of the Chemistry Department, Rothamsted Experimental Station, Mr. F. C. Bawden, Head of the Plant Pathology Department, Rothamsted, and Mr. G. V. B. Herford, Director, Pest Infestation Laboratory, Department of Scientific and Industrial Research, were appointed members of the Committee during the year.

2. In the course of the year the Committee held five 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 later sections.

3. 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 of the various informal consultative panels, which include specialists in a number of fields who are not members of the Committee.

4. A number of visits have been made by members of the Committee to Colonial territories during the year. Dr. Wright, Sir Raymond Priestley and Mr. Simmons went to the West Indies; Sir Geoffrey Clay went to East Africa and Aden, and attended the Conference of the Food and Agriculture Organization on Land Utilization in Far Eastern countries; Dr. Hall visited the West African Cacao Research Institute; Mr. Collier visited South-East Asia and East and Central Africa. Sir William Slater and Dr. Herklots were delegates to the British Commonwealth Scientific Conference held in Canberra and Melbourne, and Dr. Herklots took the opportunity to visit South-East Asia, Fiji, Honolulu and Washington to study and discuss agricultural research matters.

5. Owing to increasing demands upon the Colonial Development and Welfare funds made available in October, 1950, for agricultural, animal health and forestry research (£1,300,000) it has been necessary to scrutinize with more than usual care every application for financial assistance towards a research project. Grants made towards new and existing schemes during the year under review total £373,553.

6. Technical assistance to the Colonies has continued to be given throughout the year by the United States Economic Co-operation Administration and subsequently by the Mutual Security Agency. A further three projects recommended by the United States missions which visited Colonial territories have been completed, two others are still in progress, and in four cases applications made to the United States authorities have been approved and the recruitment of personnel is awaited. It has been necessary to cancel some projects owing to the difficulty in obtaining suitably qualified American scientists, and the implementation of certain other projects has been temporarily delayed owing to the replacement of the Economic Co-operation Administration by the Mutual Security Agency.

II. LIAISON WITH RESEARCH INSTITUTIONS

7. 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 more than one or two of these institutions. Reference is made later in this report to liaison with the Pest Infestation Laboratory, Department of Scientific and Industrial Research, and to the activities of the Adviser on Tropical Soils, Rothamsted. The work of three other institutions is described briefly below.

Commonwealth Institute of Entomology

8. One of the Institute's publications, the Bulletin of Entomological Research, was the medium for the publication of 25 papers during the year dealing with specific problems of agricultural (and also medical) entomology in the Colonies. A new project, the production of maps showing the world distribution of insect pests, was launched in response to requests received in recent years from the Colonies as well as the Dominions.

9. The Institute's information service, apart from its publications, embraced a wide range of subjects and was utilized by almost all the Colonial territories. Examples of the many topics covered are the distribution of the oriental fruit-fly in relation to the importation of fruit into Kenya, the identity and control of a species of beetle damaging rice plants in Zanzibar, and the value of attractants and repellants in the control of ants, with special reference to the fostering of mealybugs by ants on cacao in the Gold Coast.

10. The identification service of the Institute was used by 19 Colonial territories during the year. The number of consignments of specimens received from them for identification was 130, and these comprised over 25,000 specimens, or about 40 per cent. of the total received from all sources; they were sent in by 71 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 2,267, or about 30 per cent. of all the identifications done by the Institute during the year.

Commonwealth Mycological Institute

11. During the year assistance has been given by the Commonwealth Mycological Institute in a number of problems in Colonial plant pathology. The maize rust in West Africa was determined at the Institute by Dr. G. R. Bisby as *Puccinia polysora*, and this was confirmed by the author of the species, Dr. G. Cummins. From specimens in the herbarium of the Institute it was possible to trace the history of the fungus in West Africa, where it was introduced, probably by imported maize, about 1949.

12. Assistance was also given in the determination of specimens of the pathogenic fungi associated with sudden death and dieback of cloves in Zanzibar. The fungus, which subsequently was shown to be the one probably responsible for sudden death, had been received at the Institute twice before, once in 1922 and again in 1938. The specimens received from Zanzibar during the year under review produced perithecia and pycnidia, and the chief mycologist at the Institute was able to refer the fungus to *Valsa* and report that as far as cloves were concerned it had to be treated as a new species. The dieback fungus had not been received before, and the chief mycologist advised the clove research workers that he considered it to be a new species of *Cryptosporella*. He has now supplied formal diagnoses for these two species.

13. Interesting plant pathological specimens sent to the Institute for identification include, among many others, *Cercospora nicotianae*, the cause of a serious leaf spot of tobacco from North Borneo; an unrecorded *Pseudoplea* apparently causing a severe leaf spot of groundnuts in the same Colony; and

Macrophomina phaseoli attacking groundnut pods and seeds in Tanganyika. A large number of collections of *C. arachidicola* and *C. personata* on groundnuts were received from Sierra Leone illustrating the seasonal incidence of these pathogenic fungi.

14. Disinfection of various seeds in transit to various Colonies has been carried out at the Institute on a number of occasions and questions of quarantine have been referred to the Institute by various Colonial authorities. The Director, as Chairman of the Fungicides Sub-Committee of the Colonial Insecticides Committee, was responsible for editing a Survey of the position regarding plant diseases in the Colonies and the possibilities of their control.

Commonwealth Institute of Biological Control, Ottawa

15. The Director reports that the work of the Institute for the British Colonial area is extending rapidly. The collection, breeding and shipment of the parasites of mealybugs for the Gold Coast is still being continued on a large scale in California. The Seychelles have assigned to the Institute, work on the biological control of the Lymexylonid coconut pest *Melittomma insulare*. Nigeria and Fiji have requested help in the biological control of weeds. The possibility of further work on the control of the *Amblypelta* bug, causing premature nutfall of coconuts in the British Solomon Islands Protectorate, is also under consideration.

16. Some successes have been obtained in West Indian work. The Aphelinid parasite *Prospaltella* was shipped to Barbados for the control of white fly, *Aleurodicus cocois*, on palms, and investigations later in the year showed that the parasite was well established and the white fly population considerably reduced. The Braconid parasite *Apanteles glomeratus L.* was introduced into Barbados for the control of cabbage white butterfly *Ascia Monuste L.* The parasite became established and the population of *Ascia* declined. Later, *Apanteles* also declined in numbers and was thought to have disappeared, but in January, 1952, large numbers again appeared in the field.

17. Several of the Coccinellids introduced into Bermuda from California during the last few years as a possible means of controlling Bermuda cedar scales have become established; one of them, *Microweisia suturalis*, is now more abundant than *Lindorus lopanthae* in many areas, and may eventually become the more important controlling factor. Despite the work of the introduced parasites and predators, however, the cedars continue to decline and seem unlikely to survive in the Island on a large scale. Since all reasonable possibilities of biological control seem to have been exhausted, this work has now been discontinued. Some of the remaining healthy cedars appear to be naturally scale-resistant, and the Department of Agriculture is endeavouring to propagate from them.

III. REGIONAL AGRICULTURAL RESEARCH

(a) *EAST AFRICA*

The East African Agriculture and Forestry Research Organization

18. The buildings of the new headquarters of the Organization at Muguga South, Kenya, were completed, and the scientific staff moved there from Amani early in the year. The offices and laboratories were formally opened by the Secretary of State (the Rt. Hon. James Griffiths, P.C., M.P.) on the 26th May, 1951. Much remains to be done in completing the erection of greenhouses and the oil-gas plant, and in the erection of the buildings for the Animal Industry Division, which is to be controlled jointly by the Directors of E.A.A.F.R.O. and the East African Veterinary Research Organization.

19. The results of the four years' fertilizer trials, both on native food crops by E.A.A.F.R.O. and on European areas by the Kenya Department of Agriculture, are being re-examined and prepared for discussion by a Specialist Committee on Fertilizer Responses, who will report on the work as a whole. Basic research on soil fertility and soil survey will be continued by E.A.A.F.R.O., and it is greatly to be hoped that field work will be continued by the territorial Departments of Agriculture.

20. Although the soil classification of the sites has not been completed, tentative correlations show that, in the wetter districts, on sedimentary soils derived from granite, there is a widespread response to nitrogen; where these soils have been eroded a phosphate response may also be obtained. In these wetter areas red earths derived from the basement complex have given responses to both phosphate and nitrogen, and soils derived from overlying sediments and acid volcanics give a marked response to phosphate. Soils of granitic origin also respond to nitrogen, and sometimes to phosphate, in the drier areas, where laterized red earths appear to respond to phosphate. In the coastal districts, sandy soils lack the major elements and respond to phosphate and nitrogen, and sometimes also to potash. The heavier soils may be low in phosphate, but the alluvial soils have higher phosphate and potash contents.

21. The relationship between calcium and phosphate in the soil system, which was reported briefly in the 1950–51 Report, is now being extended to the analyses of plant samples from the fertilizer trials. It has been found that the amount of phosphates in the crop is highly and directly related to the degree of saturation of the base exchange capacity of the soil. It appears that, in acid soils, the base-linked phosphate is available to the plant, while the phosphate which is directly absorbed into the clay complex is much less available. In this field of soil fertility, work is also proceeding on the effect of termite activity on soil fertility and, although it is yet too early to draw conclusions, it can be said that, so far as the *Macrotermes* group is concerned, the soil of their mounds may have a higher clay content than the surrounding soil and often contains more calcium, but the marked difference in the lime content of occupied, as compared with abandoned mounds, cannot be explained without further study.

22. Lack of staff has limited field work on soil survey to classification of the sites of the fertilizer trials, to find what relationship exists between soil type and fertilizer response. In co-operation with the three East African territories and with Nyasaland, work is also being carried out on land-use surveys, and this is being tied to the work of the Ecological Training Unit under Mr. Trapnell.

23. Researches on soil physics were mainly concerned with the fate of rain water after it reaches the ground, and the results of a three-year trial on a small catchment area are being examined. This experiment was originally laid down by the Hydrology Branch of the Kenya Public Works Department and the findings from it will be a valuable guide to further trials on a wider range of conditions.

24. Work on breeding cassavas resistant to virus diseases sustained a severe blow by the accidental death of Mr. Nichols; but his records were so far complete that continuity of the work is assured in the hands of the newly established Genetical Division. Favourable reports have been received on the behaviour of certain hybrid clones distributed for trial during the past two years.

25. Studies of groundnut virus diseases continued with particular emphasis on the separation of different viruses and virus strains. The collection of wild *Arachis* species is slowly being built up and the reaction of each to the rosette virus studied, with a view to providing the Genetical Division with parental material for inter-specific crosses. Dr. Evans, whose work is co-ordinated with that of E.A.A.F.R.O.

by arrangement with the Overseas Food Corporation, is studying the bionomics of the aphis vector of rosette, its relation to predators and alternate host plants. A new project is the study of sweet potato viruses, which have caused heavy losses in parts of the Belgian Congo and are known to occur in all three East African territories.

26. In forest pathology, studies of the canker disease of cypresses have made substantial progress in elucidating the resistance of different species to strains of the fungus and the relation between age of tree and susceptibility. Local studies have been undertaken by the Organization's Pathologist in collaboration with the Forest Products Research Laboratory of the Department of Scientific and Industrial Research which have shown the range of fungi responsible for serious and rapid deterioration of timber fishing-vessels on Lake Victoria.

27. In plant physiology, work has been begun on the pyrethrum plant with special reference to the incidence of the bud disease caused by *Ramularia bellunensis*. The work is being done at the request of the Pyrethrum Board of Kenya, and in collaboration with the Kenya Agricultural Department. Preliminary observations have suggested a relationship between climate and disease and it seems likely that continuous dampness of the environment of the plant is more important than the actual rainfall. The eco-climate of the clump may be the key factor, since there are indications that buds formed on stalks which have risen above the clump are not often attacked, whereas buds developing within the clump are readily infected.

28. The forestry division of E.A.A.F.R.O. is now collating silvicultural problems in East Africa, and experiments on nursery technique, both in the territories and at Muguga, are yielding results of economic importance. Records of past work, long buried in departmental files, are now available. In so far as facilities allow, this Division is undertaking the following lines of work; collection and distribution of information; standardization of research procedure; softwoods; enumerations; regeneration of hardwoods; short term tree cropping; and yield tables for important species.

29. The Entomologist of the Kenya Forest Department has been transferred to E.A.A.F.R.O. in order to widen the scope of his work to include other territories. In the Kenya Department his main problem was that of *Oemida gahani*, which is a major pest in Kenya and may spread to other parts of East Africa. This work is being continued but, in addition, so far as very limited facilities permit, he has started a survey of the forest insects of East Africa.

30. The first year's work on crop insecticides has been mainly exploratory, but it included field trials on *Lygus* and bollworm in collaboration with the entomologists of the Empire Cotton Growing Corporation and the Department of Agriculture, Uganda.

31. Dr. M. H. French will in due course take up his duties as Head of the Animal Industry Division which will be controlled jointly by the Directors of E.A.A.F.R.O. and E.A.V.R.O. In the meantime, the Division's farmland is being broken to the plough and cleaned by cropping, in preparation for the main planting programme, and a start has been made on the farm and experimental buildings, including the building for metabolism research on farm animals.

The East African Veterinary Research Organization

32. The development of the new headquarters at Muguga, where all central activities of the Organization will be conducted, proceeded during the year. The area of Muguga North, where research into animal diseases and the manufacture of biological products will be carried out, comprises some 1,000 acres, and the work of fencing, terracing of arable land and road building is making good progress.

33. With the construction of the first dip-tank and the purchase of a large herd of cattle immune to East Coast Fever, the area is being finally cleansed of ticks.

34. Foundation stocks of highly standardized strains of laboratory animals have been obtained and are being built up.

35. The research on animal trypanosomiasis, including that on Antrycide conducted jointly with the East African Tsetse and Trypanosomiasis Research Organization, has continued. At a coastal field station, in a *Glossina austeni* area, experiments with the antrycide mixture indicated that injections should be carried out not less frequently than every two months, and that treatment effective in the early stages was much less so in the chronic stage. Observations were made on the resistance to trypanosomiasis of calves exposed to tsetse from birth. Studies of the development of drug fastness have been continued, and also experiments on inducing blood infections in cryptically infected animals by the inoculation of K.A.G. rinderpest virus. At the laboratory, pathological studies, including that into the anaemia of bovine trypanosomiasis, were continued.

36. In East Coast Fever, research into the pathology, pathogenesis and the parasite at various stages of fatal and recovering cases, was continued, early in the year at Kabete, and later by the same worker, under the guidance of Professor Taliaferro at the University of Chicago, by means of a Commonwealth Fund Fellowship. The American studies include those on tissue culture applicable to intracellular protozoa and on serological tests for protozoan diseases with a view to their application to the Theilerias, and later, possibly, to other protozoa; and on general American lines of research on protozoology. The field investigation of the incidence and morbidity of E.C.F. in Epizootic areas was continued. Strains of ticks have been maintained for use in disease transmission experiments, breeding of various species and observations on life cycles and investigation of morbid anatomy and histology.

37. The research on animal helminthology has continued and has comprised further studies on the systematics and life-cycles of ruminant paramphistomes and on the bionomics and development of *Haemonchus contortus* larvae on pasture. The life-cycle of *Paramphistomum microbothrium*, a common stomach fluke, has been completely worked out in cattle and the snail intermediate host. A new species of paramphistome infecting cattle, *P. sukari*, has been found and its intermediate snail host determined experimentally. A third, hitherto unidentified *Paramphistomum* and also *Cotylophoron cotylophorum* are being studied; the intermediate host of these flukes has not hitherto been found. These studies on flukes of domestic livestock are being extended to bovine bilharzias. An extensive series of experiments on *Haemonchus* larvae confirmed the observations made in 1950 on seasonal development on pasture; these are of value in indicating seasonal treatment and grazing management to reduce transmission of parasitic gastro-enteritis, one of the most important diseases of sheep and goats in East Africa.

38. The tuberculosis survey and investigation carried out by the mobile unit in the Southern Highlands Province of Tanganyika since November, 1949, was closed at the end of 1951. The results are summarized as follows. A total of 39,607 head of cattle was tested by the single comparative intradermal test at 65 centres. The number of cattle tested and percentage found infected in each of the five Districts were: Iringa, 15,500—9 per cent.; Mbeya, 15,775—15 per cent.; Njombe, 2,660—11 per cent.; Rungwe, 3,941—2 per cent.; Chunya, 1,731—3 per cent. Ninety-three per cent. of 314 cattle, on which complete autopsies were made, showed lesions of the lung and the glands of the pulmonary and head systems. Fifty-two strains of *M. tuberculosis* were isolated and 24 were typed; the organism concerned appears to be a normal bovine type. Observations were made on the effect of age and work on the incidence of tuberculosis. The

disease would appear to be spreading and the present low morbidity is unlikely to continue when additional stresses, such as are associated with higher production, are imposed on infected animals. Tuberculosis is already a serious economic disease in pigs.

39. Studies on animal nutrition were continued. Twelve full digestibility trials and two mineral balance experiments were done on local grasses and hays. Seasonal variation in the nutritive value of grasses were investigated by digestibility trials and chemical analyses. Experiments using the application of Lancaster's formula and the silica ratio technique were carried out on rapid procedures for determining digestibility, in comparison with the slower orthodox methods; promising results were obtained with the silica technique. The advantages are evident of developing a satisfactory quick method of investigating the large number of Africa fodders, whose nutritive value remains unknown. A blood phosphorus survey was made on cattle in the Kikuyu Reserve; abnormally low values or clinical phosphorosis were not found.

(b) *WEST AFRICA*

40. The Secretary for Agriculture and Forestry Research, Mr. D. Rhind, after completing an extensive survey of research in the West African territories, concluded that a large scale West African Agriculture and Forestry Research Organization was not feasible, but that better co-ordination was badly needed to ensure greater efficiency in agricultural research. Proposals to achieve this are now under consideration in West Africa. In the meantime two regional research schemes covering rice cultivation and rust disease of maize have been started. One of Mr. Rhind's activities is the preparation of summaries of information on individual research problems. Two, which have recently appeared, cover information and bibliography on maize rust disease, and recent investigations on heavy soils in Sweden and their possible application to mangrove swamp soils in West Africa.

Rice Research

41. Rice is the staple food crop in Sierra Leone and in some areas is an important cash crop. A reduction in upland rice cultivation is, however, essential in the interests of soil conservation; there must accordingly be a large increase in wetland cultivation to offset this reduction and to keep pace with rising local demand, and eventually to achieve a surplus for export. The main wetland areas available for development are, however, swamps where problems of drainage, maintenance of fertility and the removal of salt and other toxic substances must be solved before satisfactory progress can be made. In 1948 assistance was given from Colonial Development and Welfare Research funds for the enlargement of the small station at Rokupr, in order to enable it to serve as a focus for regional rice research in West Africa. On the recommendation of the Committee a scheme was made during the year under review providing a further £70,600 from the Colonial Development and Welfare Research allocation to defray nearly 50 per cent. of the additional expenditure needed to enable the station to become a regional centre and to maintain it over a period of four years. The remainder of the costs are to be met by the Governments of Sierra Leone and the other three West African Colonies and from the Sierra Leone Colonial Development and Welfare allocation.

Maize Rust Research

42. In 1950 a rust disease caused by a fungus parasite, *Puccinia polysora*, previously recorded only from the warmer parts of America, became epidemic on maize throughout West Africa. It is known to have been active from the Gambia to Nigeria, including intervening non-British territories, and is probably now responsible for damage to about 50 per cent. of the crops. A Colonial Development

and Welfare Research scheme has been made to provide a grant of £34,500 towards the cost of establishing a maize rust research unit based on Moor Plantation, Ibadan.

West African Cacao Research Institute

43. The work of the Station included investigations into the diseases and pests of cacao, the agronomy of the crop, the breeding of improved types, and problems of cocoa fermentation. The study of swollen shoot disease was a prominent part of the disease investigations and included research on the inter-relations and inter-actions of the virus complexes responsible for the disease, on aetiology, chemotherapy and host resistance. In connection with this study, the ecology of the insect vectors and their possible control by systemic insecticides and by biological means were studied. As a possible means of expediting disease control, investigations were made into the use of arboricides for the destruction of diseased cacao trees and of alternative host plants. Other diseases, especially pod diseases, were also studied. Of the insect pests which received attention, capsid bugs claimed priority. A satisfactory method of control of the pests on young cacao was revised and the study of possible means of control in mature cacao is continuing.

44. Agronomical and horticultural work included the elaboration of improved methods of vegetative propagation, in which marked success has been achieved, the study of various methods of establishing young seedling cacao in the field, determination of the optimum spacing for West Africa and for introduced cacao types, study of problems of overhead shade, of rehabilitation of derelict cultivations and kindred problems.

45. The fermentation requirements of the various cacao types were studied in laboratory and large-scale experiments, with the object of improving the quality of West African produce and also of devising techniques which will enable small samples of consistent quality to be prepared for flavour appraisal by the manufacturers. Crop improvement was attempted by selection of high yielding types and their progeny, and by the study of the performance and quality of introduced types. A long-term programme of plant breeding is being implemented.

West African Institute for Oil Palm Research

46. The former Oil Palm Research Station of Nigeria has been converted by statute into a semi-autonomous Institute. Its research will cover the needs of all the British West African territories. The Institute inherits from the former Oil Palm Research Station a main research station near Benin, Nigeria, covering over 4,000 acres, and an important sub-station, covering nearly 450 acres, in the heart of the palm belt in Calabar Province, Nigeria. Experiments are also conducted at various stations of the Nigerian Agricultural Department and on private plantations and in natural palm groves. A sub-station in Sierra Leone is contemplated.

47. Progress in the capital development of the main station has been slowed down by a serious labour shortage, but about half the building programme has been completed. A certain amount of progress has also been made on the sub-station. Recruitment has improved and about half the senior and junior posts are filled.

48. In planting, which has been handicapped by the labour shortage, the "ball of earth" technique continues to be successful. Field experiments under the Agronomy Division are beginning to provide information of the greatest value to those engaged in the establishment of palm plantations. Plant breeding has been directed towards the selection of palms which will grow and yield well on the poorer soils of the Eastern Region of Nigeria and elsewhere, and the production

of improved seed by the controlled pollination of selected high-yielding trees. Seed produced during the last " seed year " should provide sufficient material to establish nearly 6,000 acres in 1953, an expansion far exceeding anything previously achieved in Nigeria. Plant pathological studies centre largely on the nursery root disease. Studies of the variation of oil content in fruit have begun.

University College, Ibadan

49. Research studies have been undertaken during the year on the following problems:—

Agriculture: Plant breeding in *Mundulea sericea* and *Helianthus annuus*. The influence of temperature and humidity on the viability of vegetable seeds. A study of fungal flora of Nigerian soils, particularly in relation to root disease fungi. A survey of diseases of growing crops. Tropical soil microbiology. Nigerian Gramineae. Taxonomic surveys of pests of growing crops, and of stored products pests in Ibadan. Carbon tetrachloride as a fumigant for grain.

Animal Husbandry and Health: Animal behaviour in the tropics, with special reference to physiological adaptations to climate, nutrition, etc., of indigenous breeds of domesticated animals. The effect of local daily climatical temperatures and humidity on the body temperature of the White Fulani (Bunaji) dairy cow. Comparative osteology of the White Fulani (Bunaji) cow. Potentialities of crosses between northern breeds of goats and the Southern Dwarf Goat as a source of marketable-grade skins in the South. Communal poultry production as applied to farmers' individual co-operative schemes in Nigeria. The rearing of production strains of R.I.R. cockerels in co-operation with the individual policy of grading up local breeds. The incidence of avian tuberculosis in local and exotic breeds. The chemical composition of common feedingstuffs at present in use in various parts of Nigeria. Nutritive values of individual pasture grasses and their variations with stages of growth and with seasons.

(c) *WEST INDIES*

50. Proposals for a regional research centre based on the Imperial College of Tropical Agriculture, Trinidad, formulated in the Colonial Office and endorsed by the Committee and the Governing Body of the College, have been submitted to the West Indian Governments for consideration. It is proposed that the centre should take over and continue the work at present being done under the three major Colonial Development and Welfare research schemes relating to cocoa, bananas and soils which are administered by the College.

Cacao Research

51. Work has proceeded actively on testing the I.C.S. clones, the establishment of a collection of cacao types of *Theobroma* species and allied genera, and on genetical investigations and breeding of improved strains, including the breeding of strains resistant to witches' broom disease. Methods of retaining the viability of cacao seeds for considerable periods (up to three months or more) have been worked out, thus enabling seed to be sent for the establishment of seedling plants in distant countries.

52. Investigations are in progress on the renovation of worn-out old cocoa lands on marginal soil types and on the biochemistry of cacao soils with special reference to the upper crumb layer. The chief feature of deteriorated cacao soils appears to be a fundamental change in the organic surface layer and in some cases an actual truncation of the soil profile as a result of erosion. Considerable progress has been made in investigations of mineral deficiences and toxicities, and diagnostic methods found successful for other crops, e.g. injection techniques and tissue

analysis by rapid chemical methods, have been successfully developed and applied to cacao.

53. Experiments on the effects of shade, plant destiny, and other climatic and environmental factors, and their interactions among themselves and with soil and nutritional factors, are in progress.

54. A study of the degree of pod-infection by witches' broom disease has shown that there are large variations in the susceptibility of different clones to the disease. The data obtained are of great practical importance in deciding what clones to plant under conditions specially favourable to the disease. Analysis of the records of virus infection indicate that, although the Trinidad strains of cacao-virus disease are not " killers " like the " swollen shoot " virus disease in West Africa, they cause an appreciable and progressive reduction in yield, and do so the more, the better the growth conditions for the cacao trees. A detailed study of the mealybug vectors of the Trinidad cacao-virus disease has been made, with special reference to life history, conditions for infection, and their predators and parasites.

55. Further studies have been made of the relation of the nitrogen content of the cocoa bean to the carbon/nitrogen ratio of the soil. Evidence has been adduced that on " bad " cacao soils the micro-element status may be a factor in their inferiority. Records of temperature during commercial fermentations of cocoa beans have been made. A small-scale laboratory fermentation method applicable to only a few beans has been developed, which it is hoped will enable good assessments of the commercial quality of a new variety to be made as soon as pod-production commences. A technique has been developed for making chocolate samples, for assessment by an I.C.T.A. tasting panel, from the beans subjected to the small-scale fermentation. A comprehensive study of the enzymes in the cocoa bean, their relations to micro-elements, and their part in cocoa quality, has been started.

56. Detailed information on the progress of the work is made public at the Conferences arranged by the Cocoa, Chocolate and Confectionery Alliance and published in their reports. The report on the 1951 Conference includes " A Progress Report on Cocoa Research at I.C.T.A." (Professor C. Y. Shephard), " Notes on the quality factor in Trinidad Cocoa " (Mr. K. W. de Witt and Mr. F. W. Cope); " Cocoa Manurial and Cultural Experiments at River Estate, Trinidad " (Professor F. Hardy).

Banana Research

57. In breeding, two important conclusions have been reached. First, that the most promising, if not the only possible breeding programme, is to raise primary tetraploids using the Gros Michel as the female parent. The good characteristics of the Gros Michel are preserved adulterated as little as possible with undesirable characteristics from the male parent, the prime function of which is to introduce genes for disease resistance. Second, that better male parents were required than those hitherto in use in Trinidad and Jamaica. A number of male parents are now available, some of them edible diploids or seeded wild varieties from the East, and others synthetic male parents resulting from crossing the former among themselves. More than half the seedlings produced from the new male parents seem to be resistant to or immune from Panama disease. The most promising seedling at present, a variety known as " 1877 ", is believed to be the first of a series of varieties all superior to Lacatan and resistant to both Panama disease and leaf spot.

58. Work on auxins and their relation to fruit development appears to indicate that parthenocarpic development is due to high auxin concentrations; artificial parthenocarpic fruits have been obtained by repeated auxin application to ovaries

of seeded forms. It has also been found possible to reduce pulp development in an edible fruit by applications of a hormone inhibitor, a process which may prove successful in breeding work as a stimulant to seed-setting.

59. Work on interspecific hybridisation and evolution is now well advanced. In general, most species have shown wide ranges of crossability, yielding hybrids with species in other sections even in some cases where the basic chromosome number differs. A most remarkable discovery is that the clone Mariani and some related clones from Assam probably represent a new species, which bridges the gap between sections *Eumusa* and *Rhodochlamys*. If it can be considered a primitive form, the centre of origin of the 22-chromosome species can be located in the Burma-Assam region with some certainty.

60. The study of the Panama disease organism and of the disease in the field has continued actively, but unfortunately no practical control measure is yet in sight.

Soils Research

61. A series of articles on the soils and agriculture of the various British Caribbean territories written by Professor F. Hardy in connexion with the Puerto Rico Soils Conference, 1950, has been published in multigraphed form in bound sets. Included is an article by G. Rodrigues entitled " Characteristic Clay Minerals of Some Soil-Types of the Lesser Antilles ". Each article is based on the consideration and assessment of the five chief soil-forming factors, viz., parent rock, climate, vegetation, topography and time. For most of the territories tripartite maps have been constructed showing the intensity or distribution of effective rainfall (Mohr's scheme), vegetation and land form. Provisional soil maps have also been constructed based on observation in the field (preliminary reconnaissance soil surveys) and on a consideration of the soil-forming factors.

Sugar Technology

62. Progress in this field is recorded in the Report of the Colonial Products Research Council.

IV. INDIVIDUAL RESEARCH PROJECTS UNDERTAKEN WITH ASSISTANCE FROM COLONIAL DEVELOPMENT AND WELFARE RESEARCH FUNDS

(a) *Gambia: Research into Soil Micro-nutrient Deficiences*

63. The traditional system of agriculture in the Gambia is shifting cultivation. The long-term problem before the Government is to work out an alternative system of cultivation to support an increasing population. Preliminary experiments by Dr. Robert Webb at Fajara in 1949 and 1950 indicated that several minor elements might be deficient in Gambia soils. On the recommendation of the Committee a Colonial Development and Welfare Research scheme has been made to assist the cost of continuing Dr. Webb's work for a further period of three years.

(b) *Flora of West Africa*

64. In June, 1951, Mr. R. W. J. Keay, Botanist to the Forestry Department, Nigeria, began his two years' attachment to the Royal Botanic Gardens, Kew, to work on the revision of the " Flora of West Tropical Africa " by J. Hutchinson and J. M. Dalziel.

(c) *Flora of East Africa*

65. Mr. J. B. Gillett, one of the four botanists employed at the Royal Botanic Gardens, Kew, on the preparation of the " Flora of East Tropical Africa ", has been attached for one year to the Kenya-Ethiopia Boundary Commission to study the flora of that area. The first part of the Flora, " Ranunculaceae ", has been published and the second, " Oleaceae ", is expected to appear shortly.

(d) *Veterinary Research Laboratory, Malaya*

66. The central laboratory, opened after the War, was temporarily accommodated in buildings which now have to be given up, and the problem of how to carry on with *ad hoc* work apart from the housing of valuable laboratory equipment has arisen. It is proposed to build on a site near Ipoh a permanent, well-equipped and well-staffed laboratory where *ad hoc* investigational work can be carried out and general indentification and classification of diseases attended to, where the normal biological products can be prepared for issue to the field and where extension work based on fundamental research carried out elsewhere will be undertaken. A grant of £95,000 has been made from the Colonial Development and Welfare Research allocation towards the capital cost.

(e) *Survey of Colonial Animal Breeding Policy*

67. Following a recommendation of the Colonial Advisory Council of Agriculture, Animal Health and Forestry in 1949 that a survey of Colonial animal breeding policy should be made, a survey confined to cattle and restricted in the first instance to Colonial African territories was undertaken in the year under review. Its objects included the collection of information on the policies followed to date on animal breeding for subsequent compilation, the preparation of material for a memorandum on the principles of livestock improvement for the guidance of Colonial Departments, and the definition of the chief animal breeding problems of the various regions. Mr. D. E. Faulkner, then Deputy Director of Veterinary Services, Kenya, and Mr. J. D. Brown, Deputy Director of Agriculture, Nigeria, were appointed to undertake the survey, which occupied about five months, and they have recently submitted a report. The cost of the project was met by a grant from Colonial Development and Welfare Research funds.

(f) *Pasture Research, Tanganyika*

68. Experimental work now in progress under this scheme is designed to throw more light on such major problems as eradication and subsequent control of undesirable thicket-forming woody species, fodder preservation for use during dry seasons and at the beginning of rains, utilization of indigenous browse plants and pod-bearing trees, and the cultivation of fodder plants and of suitable grasses and legumes which could be propagated from seed.

(g) *Pool of Plant Pathologists at the Commonwealth Mycological Institute*

69. In order to overcome the serious shortage of plant pathological workers, particularly in the smaller Colonial territories, arrangements were made for the creation of a small pool of plant pathologists at the Commonwealth Mycological Institute, Kew, who would be available for *ad hoc* work overseas. Mr. R. A. Altson, Head of the Pathological Division, Rubber Research Institute, Kuala Lumpur, Federation of Malaya, has been appointed to fill one of these posts for three years in the first instance.

(h) *Forest Botany, North Borneo*

70. The Herbarium at Sandakan, which was under the control of the North Borneo Forestry Department, was destroyed during the Japanese occupation. The Herbarium had world-wide contacts and served as a centre from which the flora of a very important section of the Malaya Archipelago was studied. A Colonial

Development and Welfare Research scheme has been made to meet in full the cost of re-establishing the Herbarium and the appointment of a forest botanist who would be considered as based on the Malayan Forestry Research Station, Kepong, but who would work for three or more years in the first instance from the Herbarium at Sandakan.

(i) *Leaf scald disease of Sugar-Cane, British Guiana*

71. This disease, generally accepted as being caused by the bacterium *Xanthomonas albilineans*, first attracted attention in British Guiana in 1950 and rapidly became a threat to the whole economy of the Colony. Arrangements were made in the year under review for Mr. P. O. Wiehe, Plant Pathologist, Nyasaland, to be seconded for six months to undertake research into the disease and its control, and also for short visits to British Guiana to be made by experts from the United States and the British West Indies Central Sugar-Cane Breeding Station. Investigations have disclosed that the disease was probably introduced to British Guiana as early as 1928. Its control must ultimately depend on the replacement of the present susceptible varieties of sugar-cane by others immune or highly resistant to the disease. On the conclusion of his visit Mr. Wiehe drew up a programme of experimental work and made recommendations regarding control measures, and the need for a survey of leaf scald and other sugar-cane diseases, such as chlorotic streak, found in the Caribbean area. He also advocated the setting up of a permanent organization to study these diseases in British Guiana.

(j) *Training of Ecologists*

72. To meet the deficiency of adequately trained scientists for ecological work in the Colonies, a training centre has been set up at the headquarters of the East African Agriculture and Forestry Research Organization in Kenya, under the direction of Mr. C. G. Trapnell, formerly Ecologist, Northern Rhodesia. Two students, selected for practical training at this centre, are undergoing one year's post-graduate instruction in the United Kingdom and will go to East Africa in the autumn of 1952. It is intended to award further studentships in 1952.

(k) *United States Technical Assistance*

73. Dr. O. J. Webster, Assistant Professor, University of Nebraska, undertook an investigation into the breeding of improved grain sorghums and maize in Nigeria.

74. Two American experts, a hydrologist and an engineer, visited Northern Rhodesia to investigate the possibility of using flood waters on the Kafue flats for rice production under mechanization.

75. The services of Professor J. C. Matthysse, an American entomologist, have been obtained for about one year to undertake research in Northern Rhodesia into the control of ticks, which act as the vectors of various protozoal diseases which levy a heavy annual toll on the livestock of much of Africa.

76. Dr. L. T. Alexander, of the United States Department of Agriculture, headed a mission to Nigeria, the Gold Coast, Sierra Leone and French West Africa, a study "hard crust" and laterite soil problems. The mission included Dr. C. Bloomfield, Rothamsted Experimental Station, and representatives of French Guinea and the Belgian Congo.

(l) *Ecological Land-use Survey, British Honduras*

77. A grant of £21,000 has been made from Colonial Development and Welfare Research funds to enable a small team of scientists to make an ecological land-use survey of British Honduras. Parts of this country are quite unexplored, and there is everywhere a great lack of basic data regarding soils, vegetation and ecology

generally. There is thought to be considerable scope for agricultural development, particularly in sugar, cocoa and bananas, which would help to alleviate unemployment caused by the depression in the mahogany and chicle trades and also to absorb immigrants from some of the over-populated West Indian islands.

(m) *Control of Melittomma insulare, Seychelles*

78. It is estimated that infestation by the *Melittomma* beetle is reducing coconut production in the Seychelles by 20 per cent. to 25 per cent., and threatens to wipe out the copra industry of Praslin Island if means of control are not found. Arrangements were made early in 1952 for Mr. L. D. E. F. Vesey-Fitzgerald, an entomologist of the International Red Locust Control Service, to undertake a brief survey of the problem, and for Mr. E. S. Brown, a member of the Colonial pool of entomologists at the Commonwealth Institute of Entomology, to accompany him and to continue the investigation for a longer period. The two officers were later joined by Dr. F. J. Simmonds, of the Commonwealth Institute of Biological Control, at the invitation of the Seychelles Government. The joint investigation is designed to discover whether biological, insecticidal or cultural control, or a combination of all three methods, would be the most profitable way of attacking the problem.

(n) *Termites*

79. The collection and study of various species by the Termite Research Unit, under the direction of Mr. W. V. Harris, is now in active process throughout East Africa and Zanzibar. During the year Mr. Harris visited the Somaliland Protectorate and made an extensive journey through the Aden Protectorate. Although the main work of the Unit at Muguga is the collection, study and identification of species throughout Colonial territories as a preliminary to control, a certain amount of control work has been undertaken. A trial begun in Uganda in 1949 to test the efficiency of certain proprietary wood preservatives is now completed and results show the importance of proper methods of impregnation. In Zanzibar, termites are an obstacle to the replanting of cloves and other trees but, as imported hardwoods are used for most of the larger buildings, damage to dwellings is less acute than in other coastal areas.

(o) *Agro-climatology*

80. During the last three years research has been carried out in East Africa to ascertain how far simple meteorological data, collected at local climatological stations, can be used to assess how much rain water passes down to the ground water table, how much remains in the soil, and how much returns to the atmosphere by evaporation from the soil and by transpiration from vegetation. One of the controlling factors, a difficult one to measure directly, is the radiation that reaches the soil from the sky and the sun. An investigation is being made to see which meteorological measurements, such as sunshine-hours and minimum and maximum air temperatures serve best to give an indirect measure of radiation. Mr. A. Walter, formerly Director of the East African Meteorological Service, who is in charge of the scheme, has developed a formula from available East African meteorological data and is now testing it against meteorological records at Kew. The formula, if found satisfactory, will be used by Departments of the East African Agriculture and Forestry Research Organization directly concerned with soil-moisture studies whose task is to develop a balance sheet for the rain under tropical and sub-tropical climatic conditions.

(p) *Pool of Entomologists at the Commonwealth Institute of Entomology*

81. The creation of this pool was announced in the report for 1949/50. Two officers have been appointed to it. As stated elsewhere, one of them, Mr. E. S. Brown, is working in Seychelles on the infestation of coconut by *Melittomma*

insulare. The other officer, Mr. C. R. Wallace, is being assigned to British Guiana to make a study of the infestation of rice by the padi bug.

(q) *Clove Research, Zanzibar*

Sudden death of clove trees

82. Sudden death in mature trees has been found invariably to be associated with a new species of *Valsa* which causes a very characteristic bright yellow stain in the wood of dead trees.

83. The pathogenicity of *Valsa* sp. to the clove tree has been experimentally proved by local inoculations to main roots and to bark. In a typical case of sudden death, however, attack seems to be on the whole root system, the absorbing roots having virtually disappeared by the time the tree is approaching death. Growth is via the cambium, and the fungus is not found near the collar until the tree is moribund or dead. Attack, such as occurs in nature, is difficult to reproduce experimentally, but mass root inoculations by spores, simulating that of the probable natural attack, are being made on groups of mature trees. The time between infection and death is more likely to be long than short, as a young clove tree, experimentally ring-barked, took longer than nine months to die. All attempts to infect seedlings and saplings with *Valsa* have failed; this agrees with field evidence that, in normal conditions, young trees are not susceptible.

84. Another method of attack by *Valsa* is as a wound parasite, the broken ends of branches resulting from harvesting frequently becoming infected. In this role the fungus grows comparatively slowly, but it has sometimes been observed to kill trees.

85. Recent work has shown conclusively that what was once thought to be sudden death in young clove trees is caused by a new species of the fungus *Cryptosporella.* This fungus always enters through a wound of some kind, such as is often caused to stems or exposed roots during cultivation; the stem or collar becomes girdled, and death of the whole upper part of the tree ensues.

Dieback of clove trees

86. Dieback occurs in clove trees in every part of the Protectorate and economically is very serious. This condition can be caused in several different ways but the major cause is a new species of *Cryptosporella*, attack by which is accompanied by a red-brown stain in the affected wood. This fungus is also responsible for what was once believed to be sudden death in young trees.

87. Infection may occur at any point where there is an open wound; once established the fungus grows back, killing successive branches, causing first the familiar "stag-headed" condition, and eventually the death of the whole tree. Trees of all ages are attacked, although seedlings up to about three years of age are usually resistant in the field.

88. The great prevalence of *Cryptosporella* dieback is wholly due to destructive methods which are now being used in harvesting the clove crop. The fungus can infect a tree only through an open wound and, after a harvest, it is common to find the ground beneath the trees strewn with branches broken off so that the flowers can be stripped more easily. It is common, too, for the pickers to lop off the tops of the main leaders of young trees for the same reason.

89. Control of *Cryptosporella* dieback is theoretically simple, but in practice, a badly infected tree (in which the fungus has already reached the main trunk) is rarely possible to treat. The Clove Research Organisation has recently carried out a control experiment on one "good" plantation where all foci of infection were cut out of 253 trees, and the resulting wounds protected with white lead paint.

Over 7,000 such infections (including over 100 trunk excavations) were removed; although new infected branches are now found from time to time, after several months no instances of continued growth of the fungus has been observed in any of the treated branches. Control measures, therefore, include prevention of damage to the trees, removal of sources of inoculation, particularly of the dead or moribund trees which it is now the practice to leave standing in the plantations, and protection of wounds.

V. RESEARCH WORK UNDERTAKEN BY COLONIAL DEPARTMENTS OF AGRICULTURE, FORESTRY AND VETERINARY SERVICES

90. This section contains a selection of items of research work carried out by the technical Departments in the Colonies; it should not be regarded as a summary of all the work which has been undertaken during the past year.

BARBADOS

Soil Fertility

91. The question of soil potash content and potash fertiliser application to sugar cane on the coralline soils (approximately six-sevenths of the Island) has come to the forefront again after several years. Early manurial trial work carried out in the Department from 1928 proved the value of this fertilizer for sugar production in the presence of economic nitrogen manuring especially for ratoon crops. Now, however, it appears from incidental observations and certain preliminary work that an available reserve has been built up in these soils, and that no response is obtained from the usual applications to plant and ratoon cane crops. A further complication has arisen in planning the work for investigating a closer control for the use of this fertilizer, namely, the general lack of experimental sites on the coralline soils where a positive response to potash fertilizer application can be obtained. Both soil and leaf analysis techniques are being used in connection with this problem.

Irrigation

92. Work of a preliminary nature has been started on the problem of controlling the application of irrigation water using the nylon block resistance technique, and early results appear to be very promising.

Entomology

93. Investigations have been undertaken into the control of the root borer of sugar cane, *Diaprepes abbreviatus*, which has been slowly but steadily increasing in some areas, by the use of Agrocide preparations and Aldrin. Recent inspections have shown that Aldrin treated halves on cane fields are already looking better than untreated halves in several cases, and so far root borer attack can be proved in untreated areas, whereas none shows as yet in treated areas. Trials have been laid down to test root crop tainting when high gamma content Gammexane dusts are used. If there is no serious tainting it is possible that these dusts will be used, broadcast and harrowed in, and not applied in cane holes before planting, a method which has not produced positive results. As costs are at present, gamma isomer treatment is cheaper per acre than Aldrin. In fields tests against wood ants and Acropyza ants which cultivate mealybugs on cane roots high gamma content gammexane dusts appear to be slightly better than Aldrin.

94. In the breeding and importation of parasites for insect control, recent successes have been the establishment of *Apanteles glomeratus* for control of *Ascia monuste*, and *Prospaltella* sp. for the control of *Aleurodicus cocois*. The coccinellid *Prodilis* sp., attacking scale insects, was also found established.

British West Indies Central Sugar-cane Breeding Station.

95. Cytological work has been directed mainly towards the evolution of a satisfactory technique for preparing material for study. It was anticipated that difficulties would be met with, on account of the chromosome numbers of sugar cane varieties: reliable fixation methods, critical staining and well-spaced metaphase plates are essential in establishing accurately the chromosome numbers. The somatic metaphase plates average about 12μ in diameter, and contain in many of the commercial B. varieties one hundred or more chromosomes. On account of the large chromosome numbers and the occasional over-lying of chromosomes in the plates, it has been found necessary to draw and count numerous plates for each variety before the chromosome numbers can be established accurately.

96. During the last few years special breeding work has been directed towards the development of pure lines of known constitution. Selfed populations have been raised from a number of varieties, and sib-crosses have also been made. Second generation selfs have been shown to possess very similar characteristics, and already show indications of pure line development. Other selfed series generally show considerable segregation development.

97. During the 1950 arrowing season, pollen grain dimensions were measured for a number of varieties of different genealogy. Pollen grains were mounted in glycerine jelly, and drawn by means of a microprojector at about x 140. Further data are required before any conclusions can be drawn concerning relationships between pollen-grain diameter and chromosome characters or other genealogical features of varieties.

98. An analysis of the stem epidermis characteristics of the Barbados commercial varieties, and the parent varieties in the breeding plots, was begun in December, 1950.

BRITISH GUIANA

Sugar-Cane

99. A total of 57 varietal experiments were harvested, of which 21 contained the new Barbados standard cane B.41227. Eighteen varietal trials were planted using B.41227 as standard and in seven of them an additional standard cane B.37161 was used. Twenty-eight varieties were imported from the British West Indies Central Sugar-Cane Breeding Station for propagation and trial. The single eye method of multiplication and introduction has proved satisfactory. The results of nine manurial trials reaped indicated that phosphatic fertilizers were unlikely to give an economic response on the majority of the Colony's cane soils, and that the present standard applications of sulphate of ammonia did not meet the requirements of the crop. In spite of wet weather considerable progress was made by the sugar companies in mechanizing cultivation. In irrigation trials marked growth difference recorded between irrigated treatments and the "Control" during dry weather disappeared with the advent of the rains, and there was no significant difference between the yields of both treatments at harvest. Minor outbreaks of the sugar-cane frog-hopper, *Aeneolamia flavilatera* Ur., were controlled by the application of Agrocide "3," and investigations continued into the biological control of sugar-cane borers.

Leaf scald disease

100. Reference is made in paragraph 71 to investigations made by Mr. Wiehe and other scientists into this disease. Research is now directed mainly to the finding of disease-resistant strains, and trials have been undertaken on varieties imported from Barbados. Other trials have been laid down to assess the resistance of all varieties in commercial cultivation. Only one of the more promising varieties,

B.4098, has shown any resistant qualities and this cane, unfortunately, appears to be very susceptible to the sugar-cane moth-borer. *Chlorotic streak disease* was found throughout the sugar-cane areas but its incidence was generally low. Experiments have been laid down to determine its effect on the germination of cuttings and their subsequent growth.

Rice

101. Further introductions of varieties were made from the East, the U.S.A. and Trinidad to assist in the breeding of a variety or varieties suited to mechanical cultivation. This programme has resulted in the production of 322 hybrids. Testing of the 12 remaining hybrids bred locally in 1943 has been completed. Manurial trials have been conducted on transplanted crops hand-cultivated and on crops grown from seed broadcast with mechanized cultivation. An economic yield response from superphosphate was obtained from large scale observation tests, and in both statistical and observation trials there was a distinct positive growth response to superphosphate with and without sulphate of ammonia. The application of superphosphate appeared to accelerate ripening of the crop by 14 days. Spoilt rice bran applications produced a beneficial effect on tillering and growth as well as on yield, and accelerated ripening by 21 days. Other investigations have been continued into the control of " volunteer " and " red " rice, the most effective techniques for mechanical cultivation and harvesting of rice, and the possibility of obtaining a satisfactory rotation crop to be grown between the main rice crops.

102. Proposals for the future development of the Mahaicony-Abary Rice Scheme envisage the cultivation of about 9,000 acres and the leasing of a further area to peasant farmers for the purpose of growing pure line seed for the Scheme. It is thought that the introduction of hardy beef cattle as a complement to rice cultivation will improve the quality and reduce the cost of rice production by avoiding the need to plough in the stubble and the drop seed crops which appear after harvest.

Jute

103. Following successful plot trials with jute some areas were planted with a number of varieties for seed bulking, and satisfactory results were obtained. A United Kingdom Mission recommended that large scale trials should be conducted to ascertain the best methods of cultivating jute and of mechanized production under British Guiana conditions and steps are now being taken to give effect to this recommendation.

Soils and Fertilizers

104. Preliminary experiments on the " pegasse " soils of the N.W. District were completed using sweet potatoes as the indicator crop. It appears that applications of ammonium sulphate and superphosphate to a sweet potato crop on exhausted " pegasse " would not be economic, although they might be just economic with virgin " pegasse." Trials with NPK and lime plus minor elements will be necessary with a range of indicator plants. Rice fertilizer trials were carried out. Analyses of soil samples and of soil water continued to indicate that ammonium nitrogen is the form mainly utilized by the rice plant. A soil survey of a potential agricultural station site of 1,400 acres was completed.

Cattle

105. Mr. J. S. McCorkle, Chief of the Range Division, Soil Conservation Service, Albuquerque, New Mexico, U.S.A., made two visits to British Guiana in 1951. His recently published report " Ranch Study in the Rupununi," contains recommendations for the improvement of ranching in general including livestock

and grazing management, disease control, marketing facilities, etc. His advice is most valuable and if followed should go a long way towards raising the standard of livestock production.

Pest Control

106. Investigations into methods of control of the Acoushi ant, *Atta cephalotes* L., have indicated that parathion and methyl bromide would probably be most valuable when used by organized extermination teams, while chlordane could be used by small farmers directly. All insecticidal treatments were considered economic.

CYPRUS

Forage Crops

107. Owing to the extreme Mediterranean climate suitable fodder crops must in the main be produced during the winter rainfall period, and at present few arable fodder crops are grown as the normal rotation on unirrigated land is simply cereal/fallow. Recent four-course rotation and fertilizer trials have shown that vetches (*Vicia sativa*), cut green, can replace the fallow with good results. Possible alternatives to vetches are now being tested.

Other Crops

108. A promising new introduction is Australian " Gabo " wheat, which is being widely tested against local varieties for drought and rust resistance and for early maturing qualities. Vine investigations include the introduction of new varieties for table grapes and for wine production and the comparison of their performance when grafted on local stocks and on American Phylloxera-resistant root-stocks. The effect on yield of inter-cropping vines with forage plants is also being studied.

Fertilizers

109. Substantial responses to the application of nitrogen and phosphorus have been obtained with potatoes, cereals, cotton, vines and citrus, although on unirrigated crops the response is much reduced in dry years.

FIJI.

Pasture

110. The collections of pasture species are being augmented at both the Sigatoka and Koronivia stations, where trials are yielding valuable information. Observations on the establishment of tropical legume-grass associations and on grazing management show that similar results have been obtained at Sigatoka and at South Johnstone, Queensland. A Guinea grass-Centrosema association has given the best results. The mixture is readily established from seed, is palatable and stands up to heavy grazing. Guinea grass can be kept low and " clumping " prevented by following a grazing-management system devised at Sigatoka. On the poor hill country at Sigatoka, Guinea grass has also been established from seed, and grazing trials by cattle and goats are in operation. Top-dressing trials with fertilizers and lime are planned. There are large areas of poor hill land on the island and these experiments, if they prove successful, should facilitate the establishment of a beef industry.

Insect Control

111. Trials of modern insecticides and of apparatus for their application have been continued. DDT sprays gave excellent control of the rice leaf-hopper, *Sogata furcifera*, in seed-beds. Both DDT dusts and sprays were very effective against the taro leaf-hopper, *Tarophagus proserpina*. Chlordane emulsion sprays gave complete control of ground-nesting ants in the field and around houses and also

eliminated other soil pests including fly-maggots and mites in mushroom-beds. An American insecticide, compound 497, has given very good results in the control of cockroaches. A British-made tropical tanglefoot band, takitak, applied to coconut palms prevented ants, stick-insects and other wingless insects from ascending. DDT dusts have proved an excellent control measure against cabbage-grubs.

112. An army-worm, *Cirphis unipuncta*, causes considerable damage and loss in rice fields and its control by means of Paris-green baits has not been entirely satisfactory. Parasites introduced from Hawaii have now established themselves throughout the rice growing areas and already it seems certain that this biological control measure is an unqualified success. In an attempt to control the weed Noogoora burr, 2,362 puparia and 1,367 larvae of the Trypetid fly, *Euaresta aequalis*, were introduced from Australia—it had previously been taken there from U.S.A. some years earlier. Though the insect has not proved successful in controlling the weed in Australia owing to its seasonal flowering, it is hoped that it may be successful in Fiji where the burr flowers throughout the year. The investigation is continuing; it is too early to decide whether effective control is likely to be obtained. Three parasites, *Ophius oophilus*, *O. persulcatus* and *O. longicaudatus*, of the fruit-flies were introduced from Hawaii. It is hoped that they will afford a measure of control of the two local fruit-flies, *Dacus passiflorae* and *D. xanthodes*.

Animal Husbandry

113. Preliminary work on the behaviour of dairy cattle in a tropical climate was completed at Sigatoka during the year. The account of this work has been prepared for publication. Climatic studies on identical twin dairy heifers were continued in co-operation with the Department of Agriculture, New Zealand. Preliminary results indicate that there is a physiological limit to growth and milk productic in a tropical climate. Growth was slower at Sigatoka especially during the h wet months, and both milk production and butter-fat percentages were higher with the sets of twin heifers reared in New Zealand on similar rations.

GOLD COAST

Coconut: Cape St. Paul wilt

114. This disease is confined to the small peninsula of Cape St. Paul, but it has spread considerably in the past year and most of the palms over an area of about four square miles are now dead or dying. A more intensive disease survey is now being conducted and, if possible, a hydrological survey will also be undertaken in the area to ascertain whether edaphic factors could be responsible for the condition. The water table of the peninsula is known to have fallen considerably within recent years and, in some places, ground water is now found to be brackish where previously it was fresh.

Entomology

115. Entomological work has been largely devoted to the stalk borers attacking cereal crops. Work continues on the bionomics and control of *Sesamia* (two species), *Busseola fusca* Fuller, *Eldana saccharina* Walker and *Proceras ignefusalis* Hampson. Particular attention has been focussed on the alternate-host aspect of control and there are strong indications that it might be desirable to abandon the use of elephant grass (*Pennisetum purpureum* Schum.) as a fallow crop, particularly in areas where *Sesamia* occurs. Good control of the latter borer has been achieved with B.H.C. dusts, and a small-scale extension programme of borer control by these means is contemplated for 1952. Following up a suggestion by Mr. D. Rhind (Secretary for West African Agriculture and Forestry Research) the important discovery has been made that the cause of a considerable proportion of the "blindness" occurring in cultivated sorghums of the Northern Territories,

formerly attributed entirely to weather conditions, is due to the sorghum midge *Contarinia sorghicola* Coq. This appears to be the first West African record of the insect.

Plant Breeding

116. *Rice.* From a variety trial involving a total of 54 varieties (including introduction from a wide range of countries), the Tanganyika rices "Kahogo" and "Afaa Mwanza" emerged best. The Indian variety D99 was next in order of merit. These three varieties considerably outyielded local varieties, and were also superior to them in other ways, e.g. straw strength. Many of the Indian varieties and all the North Borneo rices were too late maturing to suit Northern Territory conditions.

117. *Maize.* The breeding of maizes resistant to the rust species *Puccinia polysora* is a task common to all the West African territories and is to be tackled by a regional research organization (see paragraph 42). Meanwhile a close watch is being kept for any plants showing rust tolerance or resistance which might provide a source of useful genetic material. In the Northern Territories a South African maize named "Tsolo" has shown some tolerance to rust and outyielded local varieties by 50 per cent. in a non-statistical trial.

Animal Health

118. Rinderpest immunity tests have been made on Muturu and Zebu cattle vaccinated with lapinized virus and a strong immunity lasting up to 18 months has been proved. The so-called "interference phenomenon" has also been investigated, cattle showing no reaction to the injection of virulent rinderpest blood between the 48th and 72nd hours after vaccination. Investigations into resistance to trypanosomiasis of various breeds of cattle have been carried out using Zebu, Muturu and typical West African Shorthorns. Results show that resistance to trypanosomiasis varies with the three types, the West African Shorthorns being the most resistant and the Muturu the least.

Forestry

119. Large scale intensive research designed to evolve the best technique for the natural regeneration of high forest is being carried out at a number of silvicultural centres located in Forest Reserves; the treatment consists in the main of canopy manipulation. Research is also being carried out on artificial regeneration, with both indigenous and exotic species, particularly in the Northern Territories, where large scale reafforestation will be required. Standard sample plots have been laid out in plantations of *Tectona grandis* and *Cedrela mexicana*. Girth Increment Sample Plots are maintained in various Forest Reserves in the Closed Forest zone to provide data on girth increment and a reliable basis for the calculation of rotation and felling cycles.

Soil and Land-use Survey

120. 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 which the different soils support. Many of the soils mapped have been developed in old peneplane drifts which may contain ironstone concretions, massive ironstone or quartz gravel in their lower layers. The morphology of such soils is being given particular attention as erosion of the superficial earth may seriously diminish their value as media for crop growth.

Publications

121. Studies on the Fertility of Gold Coast Soils—P. H. Nye. Empire Journal of Experimental Agriculture, Vol. 19, Nos. 75 and 76. 1951.

Paper on the genus *Sesamia* by J. Bowden and W. H. T. Tams (British Museum). To be submitted to Bulletin of Entomological Research in due course.

Lime dieback in the Gold Coast—W. A. Hughes. Accepted for publication by Journal of Horticultural Science.

HONG KONG

122. In connection with an extended survey of the Colony's rainfall special equipment was installed at the Hong Kong Royal Observatory for measuring the evaporation of moisture from a vegetation-covered surface and the percolation of water through the soil; these observations may provide useful knowledge of the water requirements in the dry season of different crops.

JAMAICA

Veterinary and Livestock

123. The establishing of a fixed breed of tropically adapted dairy cattle founded on the Jersey-Sahiwal cross now appears to be within sight of realization. A development plan for the new breed has been worked out. Work in connection with the establishment of nuclear herds of " Black " and " Red " based on Angus and Red Polls was pursued. Other research work has covered mineral deficiency diseases and various types of parasitical conditions.

Pasture Management

124. Work has continued on the determination of yield and composition of grasses and grass-legume mixtures under various environmental conditions. Fertilizer and management trials of native and imported grasses and legumes have been extended.

Bananas

125. Propagation studies of the Lacatan have been completed and attention is being given now to new seedling varieties. Progress results of fertilizer trials tended to show that bananas do not respond very readily to application of potash and phosphate except in conditions of extreme deficiency of these elements, but the application of nitrogen tended to increase the rate of maturity and thereby the rate of production. Spacing trials to date show that the yields per acre in total weight of fruit in the plant crop increased steadily from the widest to the closest spacing, though not quite in proportion to the plant population since the average stem weight declined slightly from the widest to the closest spacing. Spacing 8¼ feet by 8¼ feet gave a 50 per cent. increase in yield over 11 feet by 11 feet, but at closer spacings than this the growth of the ratoon crop is likely to be retarded.

KENYA

Coffee

126. Mulching with elephant grass in the drier coffee areas has been shown, as a result of experiments over several years, to be much more effective when applied before the rainy season than after it; this indicates that the benefit is due generally to better penetration of the rain rather than the later protection from evaporation. Four years' results from manurial experiments at the Coffee Research Station have shown that no response is obtained from phosphate or cattle manure. Sulphate of ammonia at two cwts. per acre gave a small increase in two seasons, which was not significant on the four year totals, but there are indications that

heavier rates of application might produce economic responses at present prices. The beneficial effect of " toxic copper spraying " in reducing leaf-fall and dieback and increasing yields has been shown to be due to a fungicidal action of the copper and not to a nutritional effect. Comprehensive experiments are in progress to determine the best time to spray in various districts, together with optimum concentrations, rates and methods of application of spray.

Grassland

127. Grassland research has been in progress on a small scale for a number of years. A vegetation survey has been made and the ecological regions roughly mapped to provide a research plan in a country in which marked contrasts of climate are produced by elevation and the aspect of the land. Experiments have shown the need for the rational use of burning, in combination with sound management, in order to maintain the dominant *Themeda triandra* in extensive natural pastures which otherwise deteriorate, in certain areas, to a useless coarse grass phase dominated by *Pennisetum schimperii* and *Eleusine jaegeir*. Over considerable and important areas of the country the climate permits the use of leys, and the introduction of a system of alternate husbandry is of the utmost importance. Work on the selection of suitable ley grasses has resulted so far in the commercial use of three species: the Nzoia strain of Rhodes Grass (*Chloris gayana*) at elevations of 3,000–6,500 feet, Molasses grass (*Melinis minutiflora*) in the wettest parts of the Rhodes Grass zone, and *Bromus marginatus* at elevations above 6,500 feet. Other introduced and indigenous species are being investigated. Work, including fertilizer experiments, is in progress on ley establishment and management.

Animal Health

128. The main emphasis has been on methods of rinderpest vaccine production. Improved technique in the production of Kabete attenuated goat virus has resulted in a dried product, tests on which have shown that it will keep for at least 24 months at a temperature level of —30° C. This improved vaccine possesses a higher immunizing titre than previous preparations, thus reducing production costs. The use of lapinized (rinderpest) vaccine in the immunization of highly susceptible cattle such as European breeds and the Ankole cattle of Uganda, or in cattle debilitated by trypanosomiasis, has given very successful results conferring in some cases a solid immunity lasting for over two years. The control of contagious bovine pleuro-pneumonia by vaccination has never been entirely satisfactory, since the cultured vaccine used is either so " strong " as to cause severe local reactions or too " weak " to stimulate immunity, but encouraging results have followed the adaptation of a strain of the contagious bovine pleuro-pneumonia organism to growth in fertile eggs. Modification quickly occurred and by the twentieth passage a single subcutaneous dose of 1.0 c.c. of dried embryo material caused no local reaction and was followed by solid resistance to challenge by virulent organisms. The vaccine is now undergoing exhaustive tests in the field.

129. Other problems under study have been the method of spread and persistence of the virus of bovine malignant catarrh under natural conditions; the diagnosis of Rift Valley fever by serum neutralization methods; a comparison of Kenya and South African strains of heartwater Rickettsiae; the survival of heartwater Rickettsiae in the tick; the duration of immunity in sheep recovered from heartwater; the improvement of entero-toxaemia vaccine by alum absorption; the production of a satisfactory vaccine against ulcerative lymphangitis in horses; the inhibitory effects of aureomycin on *C. ovis* and of various sulpha drugs on *B. coli*; attempts to incriminate a virus as the cause of calf pneumo-enteritis in Kenya; the treatment of anaplasmosis with paludrine; the examination of the pastures of certain districts and the stock thereon for deficiencies in trace elements and minerals; the investigation of the hydrocyanic content of Perennial Kavirondo Sorghum; plant toxicology and lupin toxicity tests.

Forestry

130. Investigations were mainly designed to find methods of minimizing insect and fungus damage, that had been shown to be closely associated with injury including pruning, to stems of *Cupressus* species which are the main species of the softwood planting programme. Experiments to ascertain seasons and methods of pruning that would give the most rapid occlusion of wounds, and the effects of pruning on growth rate were started. Special attention was given to the study of *Oemida gahani* (Cerambycidae), a borer which is proving a menace to the success of the extensive softwood plantations. There are strong indications that severe attack on ornamental Jacaranda by *Orthezia insignis* (Coccidae) may be greatly reduced by the ladybird *Hyperaspis jocosa*, a small stock of which was provided by Hawaii and multiplied and released in Nairobi; this work is being continued by the senior entomologist, Scott Laboratories.

Publications

131. Bogdan, A. V.—(1951) "Important Grassland Plants of Kenya". Pitman.

Edwards and Bogdan—(1951) "A list of Kenya Grasses (with key for identification)". Government Printer, Nairobi.

MALAYA

Rice: Pest Control

132. A number of puparia of the Tachinid flies *Paratheresia claripalpis* v.d. Wulp and *Metagonistylum minense* Towns. were received by air from the Trinidad Station of the Commonwealth Institute of Biological Control for laboratory tests on the control of stem-borers. No success was achieved with *Metagonistylum*, but *Paratheresia* was successfully reared on larvae of *Proceras polychrysus* (Meyr.) and *Chilo suppressalis* (Walk.). It is hoped that a field trial with *Paratheresia* will be possible in 1952.

Soils

133. Certain areas of coastal alluvium characterized by almost pure stands of *Melaleuca leucodendron* (gelam) are, when cleared for cultivation, often associated with poor crops. Since the smell of hydrogen sulphide is often very strong in "gelam" soils a considerable amount of investigation into sulphur content has been carried out. Samples of soils from Duyong, Malacca, were rarely found to contain more than 0.3 per cent. Soils from Pulau Gadong, Malacca area, however, smelled very strongly and rapidly turned black on exposure to the air; samples taken at 24 to 36 inches contained sometimes as much as six per cent. of sulphur. The question of soluble aluminium is connected with sulphur content in soils and with the acidity which can develop on drying out and consequent oxidation. Tests to determine amounts of "active" aluminium in a large number of samples by extraction with 0.5 N acetic acid gave values up to 4,000 p.p.m. Al_2O_3 in very sulphurous soils, whereas samples from established padi areas gave values of about 400 p.p.m. Further investigations into the toxicity of aluminium to padi seedlings have been carried out using the Neubauer technique, and the application of aluminium sulphate solution to reasonably good padi clay at varying rates up to 5,000 p.p.m. was found to have a progressively retarding effect on the plants, which after treatment, were similar in appearance to those grown in certain very sulphurous soils.

Oil Palm

134. The breeding programme is concerned primarily with the development of "dumpy" palms with short stout trunks and potentially lower harvesting costs, and "tenera" palms with thick pericarp and high oil extraction rates. Sufficient

legitimate " dumpy " progeny for planting 400 acres has been distributed to estates for observation and yield trial. The acreage, well distributed as it is, should provide sufficient data on which to judge performance and, in conjunction with other progeny trials to be planted, selected parents for further breeding. *Nutrient requirements.* Leaf samples have been taken for analyses at three-monthly intervals throughout the year. Results so far appear to indicate that the amount of calcium in the leaf is directly related to bronzing, and family 97 with the most severe bronzing has the highest calcium content. On the other hand, potassium is highest in the healthy family 268 and is therefore inversely related to bronzing. The amounts of phosphorus and magnesium present are not directly related to bronzing but the K_2O/P_2O_5 ratio would seem to be directly related to this condition of the palm.

Cacao

135. Owing to the limited genetic range of locally available material, an active policy of importation has been continued. Although conditions for successful establishment of cacao in Malaya are only now being determined, most of the imported material has survived and much is growing well.

NIGERIA

Animal Health

136. *Virus and Bacterial Diseases.* Satisfactory results have been obtained in small trials with lapinised rinderpest virus on Government farms, and the keeping qualities of dried goat rinderpest virus under varying conditions are being estimated. Various methods of testing the immunity to contagious bovine pleuro-pneumonia conferred by differing vaccine strains have been studied; a collection of virulent strains of the causal organism from different parts of the country is being built up. A dessicated Strain 19 vaccine against Brucellosis which, unlike fluid vaccine, is not susceptible to temperature rises or shaking in transport, is now in general use. Some preliminary work has been done on bovine dermatitis in order to isolate the causal organism, reproduce the disease, study the histopathology of the lesions and assess the influences of nutritional deficiences and wet weather. Research has also been carried out into the use of virulent non-capsulated Anthrax strains and into vaccines against blackquarter and associated conditions, fowl typhoid and fowl pox.

NORTHERN RHODESIA

Tobacco

137. At the two Experimental Stations at Mochipapa and Msekera, seed bed experiments have included watering by capillary action, improving the retentive capacity of sandy soil by the addition of vlei soil or ant-heap and vermiculite, and the preparation of permanent seed beds using vermiculite instead of soil and chemicals in solution as food material. Research into eel-worm infestation has covered fumigation tests and tests to discover whether the application of a top dressing of compost around the plant stem will induce the production of sufficient rootlets to enable the plant to survive when the original roots are seriously impaired by infestation. Varietal trials with flue-cured Virginia and Turkish tobacco have been carried out, and four series of eight-year rotation trials have been completed. Laboratory experiments have been concerned with the treatment of seed with a mercurial compound to prevent disease and promote growth, the use of Phenol Mercury Fixtan spray against frog-eye and *Alternaria* and of " Virucide 5 " against mosaic, leaf curl, rosette and kromnek virus diseases.

NYASALAND

Maize

138. A series of variety trials in widely differing localities throughout the country were grown to compare the yield of double hybrid strains from Southern Rhodesia, imported open-pollenated varieties and local seed stocks. The hybrid seed consistently gave the highest yields and some of the open-pollenated varieties were better than local seed. Fertiliser experiments showed that nitrogen always increased the yield, and on the less fertile soils the increase was very large. A small response to phosphate application was found at some centres but at others there was no increase in yield. Potash gave no increase in yield. A spacing experiment showed that the standard spacing of 3 ft. by 3 ft. with three plants per hill gave the highest yield; 6 ft. spacing between rows, to allow of mechanical cultivation throughout the growing period, reduced the yield by some 3–400 lb.

Tobacco

139. A fertiliser experiment on flue-cured tobacco at Kasungu once again showed the importance of adequate nitrogenous fertilisation for this area; neither phosphate nor potash gave any increase in yield. The time of application of nitrogen did not have a marked effect on yield. On dark-fired tobacco at the Central Research Station, a good response was obtained to nitrogen application but phosphate gave only slightly increased yields. Breeding work on dark-fired tobacco was continued.

Fertility Trials

140. An experiment on mulching land during the dry season showed that a heavy mulch of elephant grass increased yields of subsequent grain crops.

Tea

141. Investigations into tea seed quality have shown that seed which sinks in water germinates better than seed which floats, and this factor is more important than the size of seed. Some preliminary work on vegetative propogation and clonal selection has begun. A height of tipping experiment was started and in the first year 4 inch tipping gave higher yields than 8 inch tipping, though this result may not be continued into the second year. Experiments on length of plucking rounds and the quantity and time of application of nitrogenous fertiliser are being continued.

Tung

142. An experiment with dwarf, precocious clones, planted 7½ feet square has given more than double the total yield per acre up to 5½ years of age, as compared with the best of the more vigorous types planted at 28 feet square. In a trial designed to find labour-saving types of inter-cropping, tumble-down grass slashed and mulched round the trees twice a year, with 1 lb. sulphate of ammonia applied each time, produced a yield of tung significantly greater than a permanent cover crop of the legume *Glycine javanica*. Examination of the oil from seed of five widely grown clones has shown little difference quantitatively. Investigation of characteristic leaf symptoms showed evidence of deficiencies of copper, zinc, and possibly manganese.

SIERRA LEONE

Soil Conservation

143. The report of the Soil Conservation and Land Utilisation team established in 1949 has been published. The team, consisting of three members drawn from the Administrative, Agricultural and Forestry Departments, have made a rapid survey of the natural features and resources of Sierra Leone, including eroded

and degraded areas and water supplies, and of land usage and its effect on soil and water conservation. Their recommendations, covering such matters as maintenance of fertility; conservation of water, soil and vegetation; swamp farming; rehabilitation in mining land; and legislative and administrative measures, are concerned with the immediate steps which can be taken pending further research to meet the problem of an increasing population growing food and export crops on an unstable system of agriculture. The report envisages the preparation of up-to-date comprehensive statements on geology, soils and water, and the collation of records of data obtained by personal observation and interview in each Chiefdom which might serve as the basis of a " Domesday Book ".

TANGANYIKA

Coffee

144. Experiments carried out by the Coffee Research and Experimental Station, Lyamungu, and its sub-stations, have been designed to obtain further information on the yields of clones and seedlings from the same parent tree, on the yields of second generation seedlings and the seedlings of clones, on the results of various modifications of standard pruning systems, and on substitutes for banana-trash mulch. Existing trials have further confirmed that significant increases in yield are obtainable by mulching with banana-trash at the rate of 40 lb. per tree per annum, by making up the rainfall to two inches monthly by irrigation, or by a combination of these methods; by the application of compost at the rate of four gallons per tree per year; or by pruning on the multiple stem rather than the single stem system. It has recently been found that response to these treatments may vary according to clone. Entomological work has indicated investigations into white coffee borer control by main-stem applications of certain insecticidal formulations, the control of green scale, *Coccus africanus*, and the predators of green scale and attendant ants. Investigations into the cause of " black tip " disorder of coffee in the Mbosi area are being continued with the assistance of the Government Chemist; affected plants have shown evidence of calcium and boron deficiency.

Cotton

145. The cotton breeding programme at the Ukiriguru Experimental Station is a continuous one, and aims at higher yield, quality and resistance to attack by the insect pest jassid and by bacterial blight. Trials of improved cotton strains are continuing with success. Long-term experiments have determined the significant increase in yields obtainable under Lake Province conditions by the application of manure or compost, the use of superphosphate followed by top-dressings of sulphate of ammonia, tied ridge cultivation, early sowing and thinning and early weeding. At the Ilonga Experimental Station, Kilosa, investigation into measures to control boll-worm, a very serious problem in the Eastern Province, has reached the stage where a DDT and BHC dusting technique will be tried on a fairly large scale.

Food Grains

146. The Botanist has been working on sorghum selection and breeding, aiming for strains and selections showing early maturity, high yield, palatability, good storage quality and other characteristics. None of the indigenous varieties, introductions or selections under observation fully meet all the requirements and attention is now being paid to hybridisation. Varietal trials have also been carried out on rice at the Mahiwa Experimental Station, and on wheat and other crops in the Southern Highlands Province.

Soils and Fertilisers

147. Soil investigations by the Government Chemist have been mainly concerned with field reconnaissance and laboratory examination of soils for irri-

gation. The possibility of reclaiming salty soils in the semi-arid plains is being investigated through leaching experiments, and a means is being sought of improving the physically difficult " hardpan soils " found towards the bottom of the Usukuma catena.

Sisal

148. The Sisal Research Station, Ngomeni, which is financed by the Tanganyika Sisal Growers' Association and staffed by the Department of Agriculture, has been mainly engaged on soil fertility and plant nutrition problems and latterly on the physical and chemical properties of soil types. Extensive manurial trials have shown the need for potassic fertilisers on certain soil types, the advantages of mulching and of manuring bulbil nurseries with sisal waste, and the losses resulting from premature cutting. Other work has included fibre testing, investigation of sisal bole-rot and testing of new types of land-clearing and mulch-producing instruments. Means of controlling the sisal weevil have continued to be investigated by staff of a private firm based on the Station.

TRINIDAD

Central Experiment Station

149. Field investigations continued in connection with sugar-cane, citrus, rice, fodder and annual crops. Pastures have been established and grade Sahiwal cattle have been introduced. Rotations and newly introduced field crops, fibres and fodders are under study. Further progress in the development of the station was made possible through a grant from Colonial Development and Welfare funds. Laboratories and offices are almost complete and are being occupied, while housing for junior staff is well advanced.

Sugar-Cane

150. The multiplication and initial testing of sugar-cane varieties continued with material received from the British West Indies Central Sugar-Cane Breeding Station at Barbados. Preliminary trials have been conducted with pre-emergence chemical weed-killers with satisfactory results. The control of sugar-cane frog-hopper blight by treatment of the base of the stool with chlorinated hydro-carbon insecticide achieved a high level. After suppression of the first brood by such means no appreciable emergence of second and third broods occurred.

Citrus

151. A long-term rootstock and management trial has been laid out. This is designed to compare various kinds of rootstock for Marsh grapefruit and Valencia oranges, and is in the form of a 5 × 5 Latin square. Superimposed on this trial is a split-plot experiment to compare management treatments involving (i) wet-season leguminous cover and dry season tillage, (ii) non-tillage, weed-free system, using herbicide, (iii) perennial leguminous cover crop (tropical Kudzu) and (iv) natural weed cover, cutlassed or mown. Observations are being made in the effect of various forms of cover for citrus, and comparisons between leguminous grass and natural weed cover are providing striking visual contrasts; all but the leguminous cover exhibit symptomatic N-deficiency. Evidence indicates that the epidemic dieback of West Indian seedling limes is a root disease which may be avoided by the use of budded plants upon immune rootstock.

Rice

152. Deep application of fertilizers in swamp rice showed no response over surface applications except in the case of sulphate of ammonia. Significantly increased yields were obtained with three cwt. per acre sulphate of ammonia. It now seems fairly well established that the application of fertilizers does little to improve the yield of padi in Trinidad when the return is over 2,000 lb. per acre.

Pastures

153. Work in grazing grasses has been maintained. Several areas both on the farms and at Central Experimental Station have been planted with stool forming grasses for grazing purposes and it has now been decided definitely that for grass legume, Kudzu should be grown in conjunction with these grasses, chiefly Elephant grass, Napier; Para grass, *Brachiaria mutica*; Guinea grass, *Panicum maximum*; and in the case of Tobago, Molasses grass, *Melinis minutiflora.*

UGANDA

Plant Breeding

154. During the past 16 years a collection of Sorghums has been built up and maintained at Serere comprising over one hundred tropical African varieties. Varieties from America, South Africa and the Sudan have been imported, but they do not compare with the local varieties, which not infrequently attain a yield of two tons to the acre. Sorghum is an African crop, and varieties re-imported from America in particular, which have been bred for purposes which do not concern Africa, are almost invariably found to have lost their resistance to tropical African diseases. The collection has been broadly classified as tall and (single) dwarf, lax and compact, white and red. It has also been rigorously selected for resistance to smut, *Sphacelotheca sorghi.* There are five red dwarf varieties, with yields over 3,000 lb. to the acre and with a low smut incidence. In the white class one or other of these criteria must be sacrificed to some extent.

155. Jute, *Corchorus olitorius*, occurs wild in Uganda, and its cultivation appears to present no greater difficulties than the cultivation of jute substitutes. The wild type, which is a weed seldom more than two feet high, has been selected with great rapidity, so that there are now straight-stemmed types which can attain a height of as much as 14 feet. The selected types also flower very much later. The retting of samples for spinning tests is just beginning. Commercial production is not, however, contemplated at present as the organization of cultivation and retting presents difficulties which will not be easily overcome.

Soil Investigations

156. Pedological studies were begun, in collaboration with the East African Agriculture and Forestry Research Organization, with the view to producing a soil map of the Protectorate. Fertilizer trials were continued and extended. Responses to phosphates were disappointingly low as in previous years but, owing to the abnormally wet season, highly profitable increases were obtained from sulphate of ammonia. In a normal year responses are uneconomic as there is a naturally high " build-up " of nitrate in the soil. Research on the nature of this phenomenon was continued throughout the year and this confirmed previous findings.

ZANZIBAR

Crop Diversification

157. With a view to broadening the basis of Zanzibar agriculture which at present rests on a two-crop economy—cloves and coconuts—agronomic trials have continued with cocoa, jute substitutes, derris, pineapples and chillies. Establishment trials with cocoa indicate the importance of shade and wind-breaks established ahead of planting the cocoa. *Helopeltis* sp. is the most serious insect pest of cocoa and appears to cause most damage in open sunlight. *Urena lobata* is likely to prove a useful crop, and fertilizer and spacing trials have commenced. Derris is becoming more popular and trials with rooting substances indicate that the nursery period can probably be dispensed with.

Theraptus Damage to Coconuts

158. Nutfall and Gummosis of coconuts has long been considered to be caused by poor soils, etc. In 1940 Philips and others discovered in the Solomons that both nutfall and gummosis of coconuts in that area were caused by a Coreid bug—*Amblypelta* species. Mr. M. J. Way, Clove Research Entomologist, while investigating the relationship between scales and the tree ant *Oecophylla longinoda* in connection with diseases of clove trees, discovered that nutfall and gummosis in Zanzibar were caused by another species of Coreid bug, namely *Theraptus* sp. The adults and nymphs of this bug feed on the flowers and young nuts, and cause the fall of young nuts, or gummosis in older nuts. It was soon noticed that in some areas damage was so extensive that no crops were obtained, whereas in other areas damage was negligible. In the latter areas the Red tree ant *Oecophylla longinoda* was present. Investigation showed that this ant was capable of exercising complete control of *Theraptus*. In the areas, or individual trees, where *Theraptus* damage occurred it was found that the ant in occupation was generally a *Pheidole* species, and, in a few areas around Zanzibar, the imported Asian species *Anoplolepis longipes* and *Anoplolepis custodiens*. Areas occupied by these ants fluctuate according to climatic and ecological conditions. The presence of cattle, and clearing of ground beneath coconut trees seems to favour the non-beneficial ants.

159. *Theraptus* is indigenous to Zanzibar, Pemba and the East African coast, and causes damage to nuts in all these areas. It has also been found causing damage to cacao and guava, and breeds extensively on guavas and certain wild leguminous plants.

160. Further investigations into the control of *Theraptus* either by the application of insecticides or by the re-introduction of *Oecophylla* are being undertaken by the Protectorate Entomologist.

VI. REPORTS OF STANDING SUB-COMMITTEES

(a) *Cocoa Research Sub-Committee*

161. The Members of the Sub-Committee are:—Mr. C. G. Eastwood (*Chairman*), Dr. E. C. Bate-Smith, Mr. F. C. Bawden, Dr. E. E. Cheesman, Sir Geoffrey Clay, Mr. F. S. Collier, Professor Sir Frank Engledow, Sir Geoffrey Evans, Dr. W. J. Hall, Dr. G. A. C. Herklots, Professor J. W. Munro, Mr. A. F. Posnette, Mr. R. V. Wadsworth, Mr. E. E. Wells, and Dr. S. P. Wiltshire. Two meetings were held during the year.

162. Mr. Pickles, Deputy Director, West African Cacao Research Institute, was able to attend the meeting in July when the Annual Research Programme of the Institute was discussed. The work of the Institute on arboricides has continued and some compounds have shown promise in killing large "host" trees. Experiments in biological control of the mealy bug vector of swollen shoot disease are also continuing. Considerable success has been achieved in experiments undertaken by Messrs. Pest Control Limited in the control of mealy bugs by the use of systemic insecticides. Further large scale experiments are required to determine how far this treatment is effective in controlling the spread of the disease. The Medical Research Council have carried out tests for residual toxicity in cocoa beans from trees treated with systemic insecticide, and further tests are being made by cocoa manufacturers to discover whether the treatment has any effect on flavour, keeping qualities, colour, etc.

163. The Sub-Committee have supported proposals made by the Imperial College of Tropical Agriculture, Trinidad, for an expedition lasting about one year by members of the staff of the cocoa research unit at the College and of the staff

of the West African Cacao Research Institute to various parts of the Republic of Colombia to collect wild cacao material.

164. As in previous years members attended the Annual Cocoa Conference convened in September by the Cocoa, Chocolate and Confectionery Alliance, Limited, at which were represented the cocoa industry, Colonial Departments of Agriculture and Research Institutions, and foreign producer and consumer interests. Among the matters discussed were world supply and demand, production in new areas, cocoa quality, and cocoa disease and its control in West Africa. Copies of the Report of the Conference have been sent to Colonial Governments interested in cocoa production.

165. At a meeting immediately following the Conference, to which members of the cocoa industry were invited, the Sub-Committee considered the results of investigations into both large and small scale fermentation made by the Colonial Microbiological Research Institute and the West African Cacao Research Institute; factors affecting the development of chocolate flavour; and the comparative merits of the British and American methods of assessing cocoa samples. It was suggested that comparisons should be made of the results of fermenting cocoa of the same types grown in different areas. The industry's representatives promised to give careful and early consideration to the acceptability of the high yielding Upper Amazon varieties which had been introduced experimentally by the Gold Coast Department of Agriculture.

166. Other matters brought to the notice of the Sub-Committee have included an investigation into black pod disease in Nigeria and Fernando Po by Mr. C. A. Thorold, Plant Pathologist, Gold Coast; the swollen shoot situation in Nigeria and the " sealing off " policy introduced there; visits made to Grenada and Tobago by Mr. P. Holliday, Plant Pathologist, Imperial College of Tropical Agriculture, to study and make recommendations on the control of witches' broom disease (a pamphlet which Mr. Holliday has written to assist in the identification of this disease, should it spread to other cocoa growing areas, is now in course of publication); and the work being undertaken at the Low Temperature Research Station, Department of Scientific and Industrial Research, in connection with the fermentation of cocoa.

(b) *Soils Sub-Committee*

167. Dr. E. M. Crowther has succeeded Sir William Ogg as Chairman of the Sub-Committee. The other members are Sir Geoffrey Clay, Dr. W. Davies, Dr. F. Dixey, Dr. H. Greene, Dr. G. A. C. Herklots, Mr. G. W. Jacks, Dr. A. Muir, Dr. E. W. Russell, Dr. A. B. Stewart, Sir Harold Tempany, and Dr. F. Yates.

168. At its meeting in June, 1951, the Sub-Committee assessed the relative priorities of those territories which had asked for the services of Colonial Soil Science Research Students. Four of the five holders of studentships awarded in October, 1950, were appointed after one year's training to soil survey posts in Nigeria, Northern Rhodesia, Fiji and the South Africa High Commission territories, the cost of the last appointment being defrayed in part from Colonial Development and Welfare Research funds. The fifth, a Soil Chemist, is to take up an appointment with the Rice Research Station, Rokupr, Sierra Leone, on completion of two years' training. A further four candidates were awarded studentships in October, 1951, and are now undergoing training.

169. The Sub-Committee also considered a suggestion made by the Scientific Advisory Committee of the Empire Cotton Growing Corporation that training in irrigation should be given to certain Colonial soil scientists to enable them to survey new areas where Egyptian-type cotton might be grown. Although present

Colonial requirements considerably exceed the number of soil science candidates available, it is hoped to give further consideration to this suggestion when circumstances permit.

170. Negotiations have proceeded with the Mutual Security Agency for the recruitment of an American expert to carry out a soil survey in Nyasaland, one of the approved projects arising out of the report made by three American Scientists in 1949 on the opportunities for United States technical assistance to agricultural research in British African Colonial territories. It is hoped that it will shortly be possible to obtain the services of such an expert for a period of 18 months.

171. Dr. H. Greene, Tropical Soils Adviser, Rothamsted Experimental Station, visited Colonial territories in South-East Asia during the early months of 1952 to study and advise on problems connected with swamp reclamation in Singapore, peat and gelam soils in Malaya, rice-growing soils in North Borneo and other matters. He also made a rapid reconnaissance of potential cocoa-growing areas in the British Solomon Islands Protectorate. Information on the latest developments in soils research is regularly circulated by Dr. Greene to his correspondents in Colonial territories, and they in turn refer specific local problems to him for advice.

(c) *Stored Products Research Sub-Committee*

172. Mr. G. V. B. Herford has succeeded Sir John Simonsen as Chairman of the Sub-Committee. The other members are Sir Geoffrey Clay, Dr. W. J. Evans, Mr. J. C. Glover, Mr. F. W. Irving, Dr. G. A. C. Herklots, Dr. W. F. Gibson, Mr. L. W. Phillips, Mr. C. W. Ruston, Mr. J. J. Scouler, Dr. T. H. C. Taylor, and Mr. J. Woodforde. One meeting was held in December 1951.

173. The Sub-Committee have continued to interest themselves in the work of the West African Pest Infestation Research Unit, for the scientific direction of which they are responsible, and a Working Party has been appointed to advise on this subject. Mr. Young, Director of Marketing and Exports, Nigeria, by whose Department the Unit is administered, was able to attend a recent meeting of the Working Party. The Working Party has assisted in preparing a programme of work for the Unit which includes basic investigations into the habits and ecology of insect pests under West African conditions as well as investigations which are of immediate practical importance. The work of the Unit is at present handicapped by a lack of trained entomologists but efforts are being made to overcome this difficulty.

174. The Sub-Committee have also considered the possibility of introducing into Colonial territories methods of fumigating small quantities of produce in railway wagons while in transit or awaiting transit. Experiments carried out in the United Kingdom in sealing railway box cars for this purpose with cocoon plastic and adhesive paper tape have shown considerable promise, and the Sub-Committee has recommended that if possible further practical tests should be carried out abroad.

175. Other subjects considered by the Sub-Committee were a report by Mr. T. A. Oxley on his visit to Cyprus at the request of the Colonial Government to advise on methods of grain storage, and experiments which are being carried out in Nyasaland, Tanganyika and Nigeria in the underground storage of grain for famine reserves, based on a method developed by the Argentine Ministry of Agriculture.

176. Miss J. M. Slow, the holder of a Colonial Studentship in stored products entomology, has been appointed to Kenya to advise on storage problems and to undertake research into pest infestation of stored products under the Maize and Produce Control organization.

177. A Revised Code of Practice governing the use of DDT and BHC with foodstuffs has been circulated to Colonial Governments, and has been supplemented by a set of notes on the application of insecticides to foodstuffs.

178. A technical sub-committee has prepared a critical review of existing methods for measuring the moisture content of grain in the field. It has also prepared a specification for a standard method against which existing field instruments can be periodically checked for reliability and accuracy.

179. Mr. D. W. Hall took up his duties as Colonial Liaison Officer at the Pest Infestation Laboratory, Department of Scientific and Industrial Research, in September, 1951, and subsequently visited the East African Colonial territories. He has in each Colonial territory an official correspondent closely connected with problems of foodstuff storage, and increasing use of his services has been made by these correspondents, who refer specific local problems to him for advice.

Colonial Insecticides, Fungicides and Herbicides Committee Fifth Annual Report (1951-1952)

Commonwealth Institute of Entomology,
British Museum (Natural History),
Cromwell Road,
London, S.W.7.
18th July, 1952.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Insecticides, Fungicides and Herbicides Committee for the year 1951–52.

I am,

Sir,

Your obedient Servant,

(Sgd.) W. J. HALL,
Chairman.

Capt. 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. F. A. DENZ, Medical Research Council.

DR. R. A. E. GALLEY, Secretary, Inter-Departmental Co-ordinating Committee on Insecticides.

DR. P. C. C. GARNHAM, Reader in Parasitology, London School of Hygiene and Tropical Medicine.

DR. D. L. GUNN, Anti-Locust Research Centre.

DR. G. A. C. HERKLOTS, Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.

DR. R. LEWTHWAITE, O.B.E., Joint Secretary, Colonial Medical Research Committee.

DR. HUBERT MARTIN, Department of Agriculture and Horticulture, University of Bristol.

DR. E. A. PERREN, Chemical Defence Experimental Establishment, Ministry of Supply.

PROFESSOR J. W. MUNRO, C.B.E., Imperial College Field Station.

MR. W. S. BATES, Secretary Tsetse Fly and Trypanosomiasis Committee.

PROFESSOR SIR JOHN L. SIMONSEN, F.R.S., Director, Colonial Products Research Council.

DR. S. P. WILTSHIRE, Director, Commonwealth Mycological Institute.

MAJOR-GENERAL T. A. YOUNG, O.B.E., Director of Hygiene, War Office.

Ex Officio Members

The Secretary of State's Medical, Agricultural, Animal Health and Forestry Advisers.

MR. K. G. ASHTON (*Secretary*).

Officer-in-Charge of Colonial Insecticide Research—MR. C. B. SYMES, O.B.E.

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.

DR. E. D. PRIDIE, C.M.G., D.S.O., O.B.E., Chief Medical Officer, Colonial Office.

MR. D. BISHOP, Colonial Office (*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.

DR. D. L. GUNN, Anti-Locust Research Centre.

DR. A. B. P. PAGE, Imperial College Field Station, Silwood Park.

DR. C. POTTER, Rothamsted Experimental Station.

DR. R. FORD TREDRE, Ross Institute of Tropical Hygiene.

DR. E. K. WOODFORD, University of Oxford.

MR. D. BISHOP, Colonial Office (*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. R. A. E. GALLEY, Secretary, Inter-Departmental Co-ordinating Committee on Insecticides.

DR. G. A. C. HERKLOTS, Secretary, Colonial Agricultural Research Committee.

MR. R. LEACH, School of Agriculture, Cambridge.

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MR. E. P. POSNETTE, East Malling Research Station.

MR. G. SAMUEL, Agricultural Research Council.

MR. D. BISHOP, Colonial Office (Secretary).

HERBICIDES AND ARBORICIDES SUB-COMMITTEE

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MR. F. S. COLLIER, C.B.E., Forestry Adviser to the Secretary of State.

DR. R. A. E. GALLEY, Secretary, Inter-Departmental Co-ordinating Committee on Insecticides.

DR. E. K. WOODFORD, Department of Agriculture, University of Oxford.

MR. D. BISHOP, Colonial Office (*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

FIFTH ANNUAL REPORT

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PART III—*continued*

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

FIFTH ANNUAL REPORT

PART I. GENERAL

An account of the formation of the Committee is given in " Colonial Research, 1947–1948 " (Cmd. 7493) and a brief history of the work done under its auspices is given in " Colonial Research, 1950–1951 " (Cmd. 8303).

2. *Membership of the Committee.* Professor D. M. Newitt, D.Sc., F.R.S., resigned from the Committee in October 1951, and at the same time relinquished his chairmanship of the Aircraft Trials Sub-Committee. He was succeeded as Chairman of the Aircraft Trials Sub-Committee by Air Commodore K. D. G. Collier, C.B.E., who also became an *ex officio* member of the main Committee.

Mr. S. A. Mumford resigned from the Committee in November 1951, on giving up his appointment as Superintendent of Research at the Ministry of Supply Chemical Defence Experimental Station, Porton. He has been succeeded in this office by Dr. E. A. Perren, who has been appointed a member of the Committee.

Mr. H. E. Coomber resigned from the Committee in February 1952, on relinquishing his appointment with the Colonial Products Advisory Bureau (Plant and Animal).

The Committee wish to record their appreciation of the valuable services rendered by Professor Newitt, Mr. Mumford and Mr. Coomber.

Mr. K. G. Ashton was appointed Secretary of the Committee in October 1951, in succession to Lieut.-Col. H. J. Holman, who resigned on accepting the appointment of Administrative and Finance Officer, Desert Locust Control Organization, East Africa.

3. *Meetings.* The Committee held four meetings during the period under review.

4. *Sub-Committees.* (*a*) The Malaria Sub-Committee held two meetings during the year. Its terms of reference have been revised to include the control by insecticidal methods of all arthropod vectors of disease and it has been re-designated " Sub-Committee on Insect Vectors of Disease ".

(*b*) The Aircraft Trials Sub-Committee met three times during the year and has been concerned primarily with the fixed-wing aircraft experiments which have been conducted in East Africa.

(*c*) The Fungicides Sub-Committee met once during the year.

(*d*) The Herbicides and Arboricides Sub-Committee did not meet during the year.

PART II. SUMMARY OF ACTIVITIES

5. Work has continued much as in previous years. At Porton two Entomologists, a Chemist and two Junior Assistants have continued basic studies connected essentially with factors influencing the toxicity of residual insecticides applied to houses for malaria control and the production of semi-permanent insecticidal coatings. Closely connected studies are being made for the Committee at the Imperial College Field Station and at the Rothamsted Experimental Station (paras. 20–53).

6. The team in East Africa, consisting of four Entomologists, a Physicist, a Chemist, a Senior Executive Officer and nine European Assistants, has continued laboratory and field studies on aircraft applications of chemicals to vegetation and a variety of other subjects, including mosquitoes and agricultural pests (paras. 54–80). In Mauritius the team of one Medical Officer, a Chemist, an Entomologist and five European Field Officers has continued the experiment on the control of malaria (paras. 84–88).

7. Outline proposals for studies on the application of insecticides for the control of agricultural pests, and for the eradication of malaria in a hyperendemic rural area, are being considered by the East African authorities.

8. Studies on the way in which contact poisons are picked up by insects, and the influence of particle size and the type of surface on the amount picked up, and on toxicity, have produced important results that will undoubtedly contribute considerably to improvements in insecticide formulations and methods of application (paras. 28–32 and 40–53).

9. The study of insecticidal surface coatings has reached the development and field trial stage. Treatment of various parts of ships voyaging through the tropics has given very promising results against the usual ship insects, (cockroaches, ants) and has also apparently produced some freedom from flies and mosquitoes entering at ports. But this latter aspect requires confirmation. The coatings, in certain formulations, are also of great value in the protection of marine woodwork from barnacles and in the control of book insects in old libraries (paras. 20–27).

10. In East Africa the aircraft studies in the application of chemicals to vegetation have continued, though on a reduced scale through the loss in a crash of one aircraft. The final observations on the experimental treatment of 15 square miles of tsetse bush with DDT spray show a reduction of two species of tsetse by over 99 per cent. and of a third species by over 95 per cent. In a smaller experiment a complete eradication of the residual fly population appears to have been achieved. Preliminary studies in connection with these field experiments appear to show that only particles of about 50 microns diameter and less are likely to be of use in penetrating the bush from above and in impacting on tsetse flies. The work at the Imperial College Field Station at Silwood Park, under the direction of Professor J. W. Munro and Dr. A. B. Page, indicates that particles alighting on the antennae of tsetse are more quickly effective than those alighting on any other parts of these flies. The behaviour of such small airborne particles in bush, their ability to impact on various obstacles, including tsetse flies, and the influence of local air turbulences on them are being studied in Africa and at Porton. A special investigation of conditions of turbulence in tsetse areas in Africa with a correlation between degrees of turbulence and droplet behaviour has been made by an experienced meteorologist. His report will be available in the near future (paras. 54–60).

11. Other experiments with insecticides against tsetse flies include the spraying of cattle with a DDT emulsion and their use as a poison bait in a small block of infested bush. By this means flies were reduced to nil in three to four months. The spraying by hand of vegetation along 16 miles of a stream, as a measure for the control of human sleeping sickness carried by *G. palpalis*, led to a striking reduction of this fly. A full report is expected soon (paras. 61–66).

12. An experimental application of larvicide from the air to swamps at Dar-es-Salaam in connection with the control of malaria has failed so far to provide a clear-cut result although the insecticide and the method application were apparently satisfactory (paras. 68–72).

13. Special two-year studies on the behaviour of *A. gambiae* and *A. funestus* in huts treated with BHC, DDT and other insecticides, do not support the view that

DDT is ineffective against *A. gambiae* because it repels them from the huts. They show, too, that dieldrin is considerably more effective against mosquitoes as a residual spray than either DDT or BHC and that in mud huts treated with residual deposits airborne particles of insecticide, or contaminated dust, play an appreciable part in the kill of mosquitoes (para. 74).

14. An experiment in a rural area in Malaya indicated that reduction of malaria carried by *A. maculatus* can be brought about by residual spraying of houses with DDT or BHC formulations as well as by the administration of Proquanil to the population (paras. 81–83).

15. In Mauritius, although the larviciding introduced last year has not reduced *A. gambiae* to the extent expected, malaria has virtually ceased to be a public health problem (paras. 84–88).

16. An important first step has been taken in the study of defoliants and arboricides by the preliminary experiments conducted in Africa by the Unit of Experimental Agronomy, Oxford (paras. 90–97). It is hoped that such investigations may be increased in future. Results will have application not only to such problems as the tsetse fly in Africa, but to a wide variety of problems in tropical territories.

17. An essential preliminary to active help towards the control of major crop diseases has been the production by Dr. S. P. Wiltshire, Director of the Commonwealth Mycolgical Institute, of a comprehensive review of colonial problems in this field. It is the intention of the Committee to use this as a basis for planning their future activities in this field.

18. A considerable effort has been made to develop suitable spraying equipment (paras. 35–39). Trials of three new sprayers (one knapsack, one stirrup pump outfit and one wheeled beam-pump) for residual spraying of houses for mosquito control are being carried out under Colonial conditions. The last two sprayers were designed by Dr. H. G. H. Kearns of the Long Ashton Research Station, University of Bristol. New boom and nozzle equipment has also been designed and produced for the two aircraft in Africa engaged on the tsetse control experiments. Suitable equipment is, of course, of the utmost importance if pests and vectors of disease are to be controlled economically. Efforts to develop such equipment are however still inadequate.

19. A considerable number of foreign visitors, mostly scientists from the U.S.A., have shown great interest in the results of the researches conducted by the Committee. It is gratifying to know from them, as well as from the many scientists from Commonwealth territories, that the activities of the Committee are contributing in no small measure towards a better understanding of the action and proper use of chemicals for the solution of many major agricultural and public health problems.

PART III. REVIEW OF RESEARCH WORK

Colonial Insecticide Research Unit, Porton (England) [22–41]

Insecticidal Surface Coatings (P. Bracey and F. Barlow) *[40]

20. Success in the production of an insecticide coating that will remain toxic for many months when applied to wood, metal and other surfaces used in houses and other buildings, ships and aircraft has been recorded in previous reports. Some control on the size of DDT crystals in the " bloom " produced on the surface of urea-formaldehyde coatings can be exercised by altering the surface hardness of the film. This can be effected by varying the proportion of plasticiser to urea-resin,

* Figures in square brackets refer to the corresponding paragraphs of the 1950–51 Report.

by exposing plasticised coatings to short wave ultra-violet light, or by stoving at temperatures of about 140°C. for periods of up to one hour. Excessive hardness, however, reduced the surface blooming and toxicity to zero, and when obtained by reducing the plasticiser content to very low proportions produced unserviceable coatings which were brittle and cracked spontaneously.

21. Volatile insecticides such as gamma BHC and aldrin can be contained within plasticised coatings by increasing the surface hardness by exposure to short-wave U.V. light. Urea-formaldehyde resin is opaque to this light, and hardening of the coating only takes place on the surface of the film. While excessive exposure provides a hardened skin impermeable to BHC and aldrin vapour, a controlled exposure has the effect of reducing the rate of evaporation and thus greatly extending the life of a BHC or aldrin coating.

22. Surface coatings containing pyrethrum and piperonyl butoxide gave a good knockdown of normal and Sardinia (DDT-resistant) house-flies, but there was always a high rate of recovery. It has been shown that whereas blood-feeding insects such as *Glossina, Cimex, Aedes* and *Rhodnius* are knocked down and killed by coatings containing pyrethrum or allethrin, a range of " carbohydrate " feeders like *Tenebrio* (adults and larvae), *Tribolium, Blatta* and *Musca* are paralysed after varying contact periods but are able to recover after removal from the coatings. *Tenebrio* and *Tribolium* recovered completely even after being knocked down for seven days on the coatings. The so-called " carbohydrate " feeders were affected much more severely and high death rates followed, however, if the insects were placed on coatings wetted with tap-water or if they were first dipped in water and placed on dry coatings. This suggests that, with the " carbohydrate " feeders, the presence of a detergent in an aqueous phase is more necessary to achieve destruction of the cuticular wax and consequent penetration of the pyrethrum.

23. Preliminary experiments have been made with attractants and repellants incorporated in urea-resin films. Coatings containing up to 50 per cent. iso-valeric acid on the resin solids and air-dried or cured at 90°C. for 30 minutes retained their attraction to house-flies for six weeks when stored indoors. House-flies offered a choice of settling on a resin coating containing 20 per cent. dimethyl phthalate (DMP) on the resin solids or on one without DMP, settled within a few minutes on the surface without DMP. Cotton fabrics impregnated with resin containing various organic compounds (heliotropine, m-methoxy acetophenone) reduced the biting rate of hungry mosquitoes on the human arm.

24. Insecticidal surface coatings may be applied for a variety of purposes, and field trials are now in progress. Trials in ships infested with cockroaches, flies and ants have been carried out with the collaboration of shipping companies. Coatings applied to the walls, ceiling and shelving of ships' galleys and stores have eradicated cockroaches, and in one ship sailing from London to Singapore have been fully effective in preventing re-infestation despite frequent washings.

25. Field trials made in co-operation with the Ministry of Agriculture and Fisheries have shown that urea-resin coatings containing DDT prevented barnacles from settling on wood for two years. Dieldrin and gamma BHC were not effective.

26. Laboratory experiments have shown that cockroaches (*Blatta orientalis*) are either killed or completely prevented from attacking book-bindings hand-painted with urea-formaldehyde lacquers containing synthetic insecticides. Experiments on the protection of books in libraries from the attacks of *Anobium punctatum* and other book pests are in progress.

27. Investigations have also been carried out on the impregnation of textiles with resin-bonded insecticides, and the insecticidal life of shirts and underwear subjected to continuous wear and weekly washings has been extended to six weeks by controlling the rate of blooming of DDT from the resin.

Sorption of insecticides by certain types of dried mud (A. B. Hadaway and F. Barlow) [33–36]

28. Investigations into the process of sorption of solid insecticide particles by dried mud have continued. Although high dosages of DDT particles persisted on mud blocks for a longer time than the lower dosages used in earlier experiments, sorption proceeded rapidly and after eight weeks practically all the deposit at the excessively high dosage of 400 mg. DDT per square foot had disappeared from the mud surface. The rate of sorption was not affected by the presence of a diluent in the quantities normally occurring in a wettable powder, but was reduced considerably by a layer of limewash between the DDT and the mud. DDT has now been recovered from the interior of mud blocks after surface deposits have disappeared and has been identified by melting point and labile chlorine content. An oil solution of the extracted DDT was highly toxic to mosquitoes.

Studies on the behaviour of different species of mosquitoes making contact with insecticidal deposits [22–26]

29. Previous work has shown that the effectiveness of deposits from aqueous suspensions of DDT against mosquitoes is influenced by particle size and by the type of material to which the deposits are applied. It is also known that some mosquitoes are irritated by contact with DDT and may leave treated dwellings in consequence before acquiring a lethal dose. Studies have now been made on the behaviour of mosquitoes in contact with different formulations of insecticides by allowing them to alight individually on a treated surface and measuring the time to the first flight.

30. Female *A. stephensi* were irritated by contact with different DDT formulations on various materials and flew from all treated surfaces after approximately four minutes. High kills occurred after a single contact, however, but only when the particles were small (less than 10 microns) and readily available for pick-up. Mosquitoes were also irritated by contact with fresh deposits of a BHC wettable powder P.520 and flew from treated surfaces after only one to two minutes. The intrinsic toxicity of gamma BHC is such, however, that all mosquitoes die quickly after a single, short contact. On the other hand, mosquitoes were not disturbed in the presence of BHC vapour, when contact was prevented, until they reached an advanced stage of intoxication. The time to the first flight from BHC deposits increased as the deposits aged and varied on different materials according to the rate of loss by evaporation and/or sorption.

31. Female *A. stephensi* were not rapidly disturbed by contact with deposits of chlordane, aldrin, dieldrin, compounds 269 and 711 (stereoisomers of dieldrin and aldrin respectively) and toxaphene, and remained on the deposits for more than 30 minutes.

32. There were no marked differences in the rate at which other species (*A. gambiae*, *A. quadrimaculatus*, *C. molestus*) were stimulated to fly from deposits of an insecticide, but there were significant differences in the kills obtained after contact with DDT. No kills of *C. molestus* occurred after contact with DDT particles of a mean size of six microns. Particle size of DDT was more critical for *A. stephensi* than for *Aedes aegypti*: kills of the former occurred only after contact with 0–10 micron particles whilst significant kills of the latter were obtained after contact with 0–10 and 10–20 micron particles.

Fluorescent Tracers

33. An investigation has been made into the possibility of using fluorescent tracers in aircraft sprays. Only one substance at all soluble in paraffin oils had the required sensitivity of the order of one part in 1,000,000,000 in 10 ml. of solution for analysis.

34. Particles of a fluorescent solid, salicyl-aldazine, have been used to determine the sites of pickup and accumulation when mosquitoes stand or walk on residual deposits of this substance.

Spraying installations on aircraft (R. Hill, with the co-operation of the Chief Engineer, Porton)

35. The design and development of an installation for the production of a spray with a mass median drop size of 200–400 microns diameter was completed during 1951. The constant flow automatic control arrangement incorporated in earlier aircraft spray installations has been modified for use with this apparatus. Trials carried out with this apparatus fitted to an Avro XIX aircraft have shown that the average mass median diameter is within the limits laid down, and that a constant rate of flow is obtained at both the minimum and maximum output rates. The 90° bend type of emission pipe fitted with the automatic constant-rate of flow apparatus was also modified in order to obtain a certain amount of component standardization between the two systems.

36. A new installation of the boom and nozzle equipment fitted to Anson I aircraft has been designed and manufactured as a result of experience gained by the Colonial Insecticide Research team in East Africa.

37. An exhaust smoke-producing apparatus has been fitted to an Avro XIX aircraft. Some preliminary trials to determine consumption etc., have taken place and further trials to determine the drop spectrum of the smoke produced are in hand.

38. A power operated test rig has been constructed to measure the comparative rates of wear of spray nozzles.

39. The constant valuable help given the Committee by the Chief Superintendent and staff at the Chemical Defence Experimental Establishment at Porton is gratefully acknowledged.

Imperial College Field Station, Silwood Park (England) [42–44]

40. The work on the mode of action of insecticidal deposits at the Field Station of the Imperial College of Science and Technology during the past year has included further experiments on the availability of dust deposits to walking flies and studies on the penetration of the insect cuticle by DDT. Measurements are being made of the absorption of DDT at structurally different points of the integument, from graduated doses in lanoline microdrops; the relative toxicity of these treatments, which varies from place to place, is recorded. These experiments have developed from earlier histological work on the tarsi of species of tsetse fly and blowfly. The tarsi of some mosquito species have also been examined recently, and attention drawn to the existence of sensory hairs which may influence the behaviour of the females of certain species of *Anopheles* exposed to treated surfaces.

41. Commercial dusts and wettable powders contain a lipoid soluble fraction (DDT) and a lipoid insoluble fraction (the diluent). Experiments have shown that, on surfaces which are not themselves waxy, particles of these two classes are picked up at appreciably different rates by walking insects. The lipoid soluble particles adhere more readily to the lipophilic insect epicuticle. Waxy leaf surfaces present a more complex system which is being studied.

42. Other experiments have been concerned with the spread of dust over the insect body.

43. The Committee records their indebtedness to Professor J. W. Munro and Dr. A. B. Page for facilitating and directing their work.

Rothamsted Experimental Station (England) [45]

Factors affecting the toxicity and permanence of insecticidal deposits on plants.

44. Studies of the behaviour of DDT deposits on plant waxes have been continued and the work extended to include the behaviour of DDT deposits on living plants. Modifications have been made in the Schecter-Haller method for determining DDT in order to adapt it to the analysis of deposits on leaves. It is now capable of giving reliable results on samples containing 15 micrograms or more of DDT.

45. Previous work had shown that deposits of DDT crystals on glass plates, either plain or coated with sisal leaf wax, when stored at 45° C. became less effective insecticidally, and that there was a corresponding loss of DDT amounting to 50 per cent. in a fortnight. As sisal leaf wax is not a typical plant wax, being unusually hard, it was decided to continue the work using wax from a plant which it was subsequently intended to utilise for a study of DDT deposits on living foliage. Cabbage leaf wax was selected for these experiments.

46. By extracting cabbage leaves with warm toluene, 10 gr. of wax was obtained and used for preparing 0.5 mm. thick films of wax on glass plates.

47. To find out whether the crystals of DDT could dissolve in the wax, and thereby alter in toxicity, waxed plates were sprayed with DDT suspension and stored at 45° C. They were kept in an atmosphere saturated with DDT vapour to prevent evaporation of the DDT crystals. After three weeks the plates at the higher concentrations were unchanged both in toxicity to *Tribolium castaneum* and in DDT content. At the lower concentrations both the toxicity and DDT content had increased, even the untreated control waxed plates being insecticidal. In a further experiment unsprayed waxed plates were found under the same conditions, to have picked up from the atmosphere 0.8 micrograms of DDT per cm^2 in 11 days, or enough DDT to produce a 1.6 per cent. solution in the wax. The wax film consequently acquired a toxicity to *Tribolium castaneum*, based on the LD50, equivalent to a dosage of 1.1 mg./cm^2 of 50 mm. needles of DDT.

48. The distribution of the DDT in the wax film was investigated by spraying a solution of wax and DDT in benzene on to plates at such a concentration that the resultant wax film on the plate contained about two per cent. DDT. This gave a kill of *Tribolium* similar to that obtained with the plates exposed to vapour mentioned in the last paragraph, indicating that the DDT is not concentrated on the surface of the wax layer when it is absorbed from a DDT saturated atmosphere.

49. The extension of the work to the study of the influence of leaf surfaces on the toxicity of the DDT deposits has necessitated some means of producing even deposits of insecticides on the leaves of living plants. Spraying in the Potter tower, the method previously used for spraying glass plates, could not be used for living leaves, and an alternative technique was devised.

50. A square of one foot sides is painted on a steel plate and the leaves to be treated are made to project through a slot cut in the plate. The slot is situated within the painted square and the leaves are taped down inside the square so as to lie flat against the plate. The rest of the plant is protected from chance contamination while spraying is in progress. The insecticide is applied by spraying through a nozzle similar to that used in the Potter tower. Four successive quantities, each of 6 ml., of the insecticidal formulation are sprayed on to the plate during each treatment, the nozzle being moved at a constant distance from the plate and in such a way as to describe a pattern on the one foot square and cover it evenly at each spraying. Between each spraying the leaf is allowed to dry. The patterns are such that in successive sprayings alternately horizontal and vertical movements predominate, the better to even out the deposit. This method produces a very

even deposit on a flat surface. On glass plates of 67 cm^2 surface area, sprayed simultaneously, the coefficient of variation of a deposit of dye determined spectrophotometrically is about five per cent. On plates sprayed successively it is rather greater, so when a leaf is sprayed, a plate is sprayed alongside and subsequently analyzed to give an estimate of the deposit density on the leaf.

51. Using this technique, it has been demonstrated that there is a difference of toxicity between the same deposit density of DDT on leaf surfaces from different plants. A much more marked difference is apparent between all leaf surfaces so far tested and plain glass plates, the latter being invariably considerably less toxic. It seems likely that this latter difference is mainly due to the increased humidity to which the test insects are exposed when on the leaf surface. Evidence for this was provided by comparing the toxicity of DDT deposits on glass plates with that on dry and damp cellophane. The toxicity of DDT on damp cellophane was greater than that on either dry cellophane or glass; taking the toxicity of deposits on glass plates as the standard of reference, the toxicities of deposits on leaves and on damp cellophane were about the same.

52. Further work on several species of living plants is in progress to investigate the rate of disappearance of insecticidal deposits from their leaf surfaces.

53. The Committee wish to record their indebtedness to Sir W. Ogg and to Dr. C. Potter for facilitating and directing this work.

Colonial Insecticide Research Unit, East Africa [46–61]

Insecticide Applications from Fixed Wing Aircraft against Tsetse Flies (K. Hocking and staff) [46–47]

54. *Aerial Spraying.* The aircraft used in these studies are owned and operated by Airwork Limited. The Committee wishes to acknowledge the valuable co-operation of Airwork Ltd. and the skill and enthusiasm of their air staff in these operations.

(i) *Results from Gallapo, Kikore Block.*

This experiment conducted last year consisted of seven aircraft applications each of $\frac{1}{4}$ lb. DDT per acre (in oil solution) to about 15 square miles of bush infested with three species of tsetse flies. Two Anson Aircraft fitted with boom and nozzles were used. The final results, a year after the last application, show a reduction of *G. morsitans* by 99.1 per cent., of *G. swynnertoni* by 95.6 per cent., and of *G. pallidipes* by 99.9 per cent.

The catches of *G. morsitans* and *G. swynnertoni* rose to a normal seasonal peak in April and May but in December and January, one year after the completion of the spraying, had fallen again to 0.67 per cent. and 0.87 per cent. respectively of the pre-treatment levels.

Catches of *G. pallidipes* remained at less than 0.01 per cent. of their previous level thoughout the year.

There is therefore no evidence so far that the populations are returning to their previous levels.

(ii) *A second spraying of a previously treated block of infested bush during the long rains with BHC.*

This block of nine square miles of bush infested with *G. morsitans* and *G. swynnertoni* had been treated in 1949 with eight fortnightly applications of BHC smoke produced by injecting 10 per cent. solution of BHC in kerosene and furnace oil into the exhausts of aircraft. This reduced *G. morsitans* and *G. swynnertoni* by about 93 per cent. Since then the flies

have increased and it was considered useful to try a second series of applications during the wet season whilst the bush was in full leaf. This was done with only one aircraft, fitted with boom and nozzles, and using a 20 per cent. solution of BHC in oil at a lower emission rate and greater swathe width. The heavy rains however (40 inches in two months) greatly interfered with operations and reduction of flies was only about 90 per cent.

(iii) *Spraying of thicketted ravine containing G. pallidipes.*

With the assistance of the Tanganyika Tsetse Department a thicketted ravine near Arusha was selected for spraying. Fly rounds were carried out under the direction of the Provincial Tsetse Officer, and spraying started in July. Unfortunately during the third application, in bad weather conditions, the plane crashed and was burned out. Fortunately there were no casualties but the experiment had to be abandoned. Useful experience was, however, gained in spraying such areas with the aid of a pre-arranged plan on aerial photographs without ground markers.

Elimination of Tsetse Fly at Atta Island (Southern Masai, Tanganyika).

55. This experiment is intended to investigate the possibility of eliminating tsetse flies from an isolated patch of bush. Atta Island is a block of bush about 2,000 acres in extent where the fly (*G. swynnertoni*) had been reduced by a BHC smoke experiment carried out in 1949 by the East Africa Tsetse and Trypanosomiasis Research and Reclamation Organization (E.A.T.T.R.R.O.) to a level of 5.6 old males per 10,000 yards in August 1950. Approximately this level was maintained for the next 18 months and the mean weekly catch during October and November 1951, before spraying was 15 flies with an apparent density of 4.4 old males per 10,000 yards. A 10 per cent. DDT oil solution was used for eight applications at a normal dosage of 0.25 lb. of DDT per acre.

56. The applications were greatly interfered with by unseasonable heavy rain and by the bush which was in leaf throughout the spraying period, and only four were carried out to schedule. But despite this no old male flies have been caught since the second application and no flies at all for two months. It is proposed now to carry out intensive searches, with cattle as bait, and if any flies are found to treat the block again after the rains.

Physical assessments of insecticides from aircraft (Mr. D. Yeo).

57. Aircraft installations have been developed to give drop spectra of widely varying mass median diameters, but, although the behaviour of droplets with diameters greater than about 200 microns can be adequately described in terms of the terminal velocities of the droplets and the mean wind speed, and although droplets less than 200 microns in diameter have been much used in an empirical fashion to control insect pests, there is little systematic knowledge of the effect upon their behaviour of meteorological conditions, vegetation cover and other field variables.

58. Experiments carried out by the team have so far shown that a correlation exists between the degree of atmospheric turbulence and the distribution and deposition of these finer droplets. Screening effects of vegetation and the deposition of small droplets on test insects are being studied. The results of the investigations should form an adequate basis upon which control measures with such droplets may be designed.

Meteorological investigations: A special study (Mr. W. Thompson)

59. Climatological readings in an open situation have now been made for one year, and it is hoped that a detailed account of the variations in conditions of

turbulence for various times of day and for different seasons will soon be available. This should be of considerable value in planning aerosol applications in East Africa. Some investigations have also been made into turbulence in acacia woodland.

Aerial Photography

60. Using an aerial camera borrowed from E.A.T.T.R.R.O., Mr. Alkin of Airwork Ltd. has constructed photographic mosaics of Atta Island, of the *pallidipes* ravine area, of Ukara Island near Mwanza, where it is suggested a joint experiment with the Director, East African Medical Survey, may eventually be carried out, and of the Musoma area proposed as a site for a large scale tsetse eradication experiment.

Insecticide applications to vegetation by ground equipment against tsetse flies [48–50] *Kibigori in Nyanza Province, Kenya*

61. The Chief Field Zoologist of the Kenya Tsetse Department asked for assistance in view of an outbreak of Human Sleeping Sickness at Kibigori, and a joint experiment was carried out. The vegetation along the edges of 16 miles of the River Mbogo was sprayed from knapsack sprayers three times at fortnightly intervals with Murphy " Dedetane " paste during February and March 1951, and then again less successfully with DDT emulsion during heavy rain in April. The reduction in the catches of *G. palpalis* was spectacular and during April and May very few flies were caught. In June the catches at the lower end of the Mbogo adjoining the next tributary rose and the Kenya Department started spraying again and later extended treatment to neighbouring streams.

62. The rate of application was about one lb. of DDT to 100 yards of both banks and at this dosage. 20 seconds exposure of tsetse to the leaves indicated that the deposit was still lethal two weeks after the application.

63. The cost for insecticide was approximately £7 per mile per application making the cost of four applications about half that of sheer cleaning.

64. A full report on this experiment is being written by the Chief Field Zoologist, Kenya.

Insecticide application to cattle against tsetse flies

65. This experiment was closely based on that carried out by E. F. Whiteside of E.A.T.T.R.R.O. at Shinyanga in 1947 but was directed against *G. morsitans* and *G. swynnertoni* instead of against *G. pallidipes* with, it was thought, greater hope of success thereby. Through the courtesy of the Director, E.A.T.T.R.R.O., Mr. Whiteside was able to give us much valuable advice and has analyzed the data obtained.

66. Twenty-two cattle were sprayed twice weekly, firstly with " Rucide " and later with a laboratory prepared resin DDT emulsion, and kept in four herds in a block of bush half a mile square near Kikore. The population of *G. morsitans* has fallen steadily and is now apparently near extinction; that of *G. swynnertoni* has not fallen so rapidly but whether that is due to immigration aided by game movement has not yet been determined. Daily catches on a spiral fly round have been made. The average daily catch of *G. morsitans* before the experiment started on 7th November, 1951, was about 20. This fell to one in December, to 0.4 in January, to 0.08 in February, and so far no flies have been caught in March.

Experiment against mosquitoes for the control of malaria [51–54]
Residual spraying of houses in a rural area

Kasenje

67. The experiment involving the spraying of houses in six mulukas (districts) in this area was completed in February 1950. Results were reported in the Annual Report for 1949-50. Routine observations have been continued for two years and observations on malaria for 16 months after the last spraying. The malaria incidence in all districts has now returned approximately to that of May 1946, before spraying started.

Aircraft application of Larvicide at Dar-es-Salaam

68. During the long rains of April and May 1951 the creeks to the north of Dar-es-Salaam were sprayed weekly with DDT to see whether this would prevent the seasonal peak of *A. gambiae* presumed to be responsible for most of the malaria acquired in Dar-es-Salaam.

69. The total area sprayed was approximately five square miles and the insecticide used was Shell Malariol H.S. containing five per cent. DDT. This was applied at a nominal dosage of 0.125 lb. per acre.

70. Catches of adult *A. gambiae* at key points in the township did not rise to anything like the normal peak levels; catches in Ilala in May 1951 were four compared with 118, 103, 12 and 29 in the four preceding years. Rainfall in 1951 was about as ample as that of 1947 and 1948. But it is not easy to say how much of the apparent reduction was due to the air-spraying. Catches in stations outside the township but adjoining the sprayed areas did not remain as low as would be expected from 100 per cent. larval kill but the adults caught may have emerged from unsprayed areas or from the creeks during the ten day period when spraying was prevented by an accident to the pilot of the aircraft.

71. It is intended that these catches which were organized and carried out by the East Africa Malaria Unit, with whom this experiment was jointly undertaken, should continue through the coming rains, when more information on the efficacy of the air-spraying should become available.

72. The total cost was about £3,500, of which £500 was contributed by the Dar-es-Salaam Municipality and £1,000 by the Tanganyika Government.

Proposed large scale house spraying experiment (Taveta-Pare area)

73. An area for an experiment to study the effect on hyperendemic malaria of the residual spraying of houses over a large area was selected some two years ago. The financial proposals have not yet been approved but routine mosquito catches throughout the Taveta area have now continued for twenty months and those in the Gonja area, although interrupted by an outbreak of plague, have now been re-established.

Special studies on the behaviour of A. gambiae and A. funestus in huts treated with DDT and BHC (G. Davidson) [55]

74. These studies were terminated in August. The conclusions so far reached from these experiments may be summarized as follows:—

(*a*) DDT: 200 mg. per sq. foot of an effective preparation of DDT killed about 70 per cent. of Anophelines (*A. gambiae* and *A. funestus*) entering huts over a period of at least six months. Most of the remaining 30 per cent. were driven out with sub-lethal doses.

(*b*) BHC: A similar dosage of an effective BHC preparation gave 100 per cent. kill for about five weeks but the kill fell to less than 50 per cent. after about three months.

(*c*) *Dieldrin:* An unknown dosage of dieldrin (possibly 50 mg. per square foot) gave a complete kill of all mosquitoes entering huts for about three months and continued to kill over 90 per cent. for at least another six months.

(*d*) Air-borne particles of insecticides or contaminated dust, presumably from mud walls and floors, showed appreciable toxicity to mosquitoes in treated huts.

Laboratory Work (G. F. Burnett and R. A. E. Rapley)

75. Laboratory work has included studies with impregnated cloth screens and DDT-treated cattle against tsetse; extracts of parts of cattle as attractants for tsetse; the effect of wood smoke on residual insecticides; the possible fumigant action of dieldrin against mosquitoes and mosquito larvicides.

76. Colonies of *A. gambiae* and *Aedes aegypti*, of cotton stainers and of *Tribolium* and *Calandra* have been started.

Chemical Work (J. Robinson)

77. The work of the chemical section has consisted mainly of the routine examination and analysis of samples from our experiments and those of other organizations. A considerable amount of work was done for the Desert Locust Survey.

78. Investigations are being made of the efficiency of present sampling methods, and ways of improving them.

Agricultural Work

79. Mr. Walker (entomologist) has been seconded to the Kenya Department of Agriculture, working under the direction of Dr. Le Pelley since April 1951. His activities have included the designing of test methods, the breeding of test insects and experiments in the control of fruit flies, scale insects on citrus and in the control of chafer grubs.

80. Mr. Jones (field officer) has been working with Mr. Michelmore of the Uganda Department of Agriculture, partly in devising apparatus for the application of insecticides to agricultural crops under Uganda conditions and partly in supervizing field trials on the control of *Lygus* on cotton.

Malaria Control in Malaya [62]

Investigations with residual DDT and BHC

81. This experiment, conducted by the staff of the Institute for Medical Research, has for its aim a comparison of the effect on malaria in three occupied valleys of residual spraying with BHC and DDT wettable powders and the oral administration of Proguanil. The treatments started in August 1949 (see 1949–50 Annual Report). During 1951 there was a decrease of malaria in all four valleys, including the untreated comparison area; the parasite and spleen rates of children 12 years and under examined at the half-yearly surveys are summarised below:—

Area	Number examined	Parasite rate per cent.						Spleen rate per cent.					
		Surveys 1949		1950		1951		Surveys 1949		1950		1951	
		1st	2nd	3rd*	4th	5th	6th	1st	2nd	3rd*	4th	5th	6th
DDT	378–492	40	33	16	12	5	4	66	64	45	36	23	17
BHC	138–175	32	28	17	12	12	3	60	59	45	48	30	26
Proguanil ...	288–458	37	25	5	3	1	1	59	53	34	20	15	15
Comparison ...	273–337	28	24	17	24	18	9	54	54	49	51	34	40

* Control work started about four months before this third survey.

82. The fall in rates in the two valleys where the houses are being sprayed with residual insecticides has been slower than in the proguanil-treated area, but has been remarkably steady, particularly in the DDT area; the present indications are that a very similar end-point will be reached in each of the treated areas. Despite the unexplained drop in the latest parasite rate in the comparison (untreated) area, the spleen rate there has remained high.

83. This effect on malaria in the two sprayed valleys has been accompanied by some reduction in the numbers of adult *Anopheles maculatus*, the vector species; the reduction has been more noticeable in the DDT valley. The numbers of larvae, however, show no marked change, and it is clear that residual spraying does not cause any dramatic reduction in populations of *A. maculatus*, which feeds freely on cattle and other animals, besides man.

Malaria Eradication Experiment in Mauritius

(Dr. Dowling and staff) [63–66]

84. This experiment was started at the end of 1948. Residual spraying with DDT (with BHC for a time in one district) has eliminated *Anopheles funestus*, the main vector of malaria, but not *A. gambiae*. Larviciding was therefore adopted and extended to the whole of the malaria areas in 1951. The promising early results were not maintained, however, and this species was found breeding rather widely in most districts in the first quarter of 1952. Adults of *A. gambiae* are, however, not found in numbers in houses. The malaria rate has continued to fall: there is virtually no transmission in any part of the island except in the Black River district, in which *A. gambiae* is breeding prolifically in the unoccupied forest areas. Here the parasite rate in children in March 1952 was less than 0.5 per cent. The entomologist has conducted a large number of day and night searches in houses and other buildings and in natural vegetation to ascertain the whereabouts of *A. gambiae* adults. Extremely few specimens were taken in day catches in houses but appreciable numbers were found in cowsheds. From 56 night searches in houses, 32 specimens of *A. gambiae* were obtained, whilst in 29 night searches in cowsheds 217 were caught. In addition, 134 specimens were caught whilst attempting to feed on a man in a total of 34 catches in a closed van or lorry. Searches in vegetable debris and boulders on the edge of a newly planted cane field yielded about 300 adults, including 112 females. Breeding of *A. gambiae* was discovered on three small uninhabited islands off the coast of Mauritius. The fauna of these islands consisted mainly of deer, rats, birds, bats and mongoose. Wooden kegs placed in grass and in other sheltered positions amongst the vegetation attracted fair numbers of adults of which some 50 per cent. were fed. In a pond on one of

the islands separated from the sea by a sand bar and containing water with 24 grams of NaCl per litre, this species was breeding well (sea water nearby contained 32 grams of NaCl per litre). Some of the adults bred from this water were of the four-banded palp variety.

85. Appreciable numbers of *A. coustani* and large numbers of *C. fatigans* occurred in house catches. The former was also present in considerable numbers, attempting to feed, in night catches near large swamps that in pre-treatment days produced very large numbers of *A. funestus*. None of this latter species could be found.

86. Dissections of 116 *A. gambiae* and of 257 *A. coustani* were made for sporozoite examinations. No positives were found.

87. *A. gambiae* and *C. fatigans* were found infected with *W. bancrofti.*

88. The advisability of continuing the attempt to eradicate *A. gambiae* in view of the virtual cessation of malaria transmission is now being considered.

Fungicides

89. Knowledge of plant disease incidence and distribution in the colonies has been considerably augmented by further contributions from plant pathologists. This is now being incorporated in a Survey of Plant Disease compiled by Dr. S. P. Wiltshire, Director, Commonwealth Mycological Institute. A request from Jamaica for advice on spraying to control Banana Leaf Spot is being met by the despatch of an expert in the near future.

Herbicides and Arboricides

90. A member of the Agriculture Research Council Unit of Experimental Agronomy at Oxford, directed by Professor G. Blackman, visited East Africa to initiate studies. Experiments were undertaken in conjunction with the Colonial Insecticide Research Unit, Arusha, and the Tsetse Research Division of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization, Shinyanga.

91. The most important uses of arboricides and defoliants in tsetse control problems would be:—

1. To kill standing trees and shrubs which it is desired to eliminate in discriminate clearing.
2. To control regeneration from stumps and roots left after hand clearing of woody plants.
3. To defoliate woodland or scrub with a view to rendering the habitat unsuitable for tsetse fly, particularly in areas where it is desired to eliminate the flies without destroying the cover of woody plants.

92. Four experiments were started to determine the efficiency of esters of various chlorinated phenoxyacetic acids for controlling "miombo" regeneration (*Isoberlinia globiflora* dominant) and "thorn-bush" regeneration (*Dichrostachys glomarata* and *Markhamia obtusifolia* dominant). Certain small thickets containing a variety of other species were also treated. One of the more immediate and unexpected effects of these treatments was defoliation of some species, but any permanent damage or death caused by the treatments cannot be assessed until 1952, i.e. the rainy season subsequent to application.

93. An aircraft application of butyl 2, 4, 5-trichlorophenoxyacetate was made to a strip of bush covering a range of vegetation types. Observations were made on the degree of defoliation, but any assessment of the arboricidal effects must wait until 1952. The retention of spray by foliage of *Isoberlinia globiflora* trees was measured in this trial and will be correlated with the full results when available.

94. A technique was devised for use in the field to compare chemical defoliant treatments on a micro scale. This involved the application of measured droplets of solutions to individual leaves or leaflets. Using this technique 34 compounds were " screened " for defoliant activity on *Grewia bicolor*, *Combretum parvifolium* and *Hippocrates obtusifolia*, three representative woody plants of wide-spread tsetse habitats in Tanganyika. A number of these compounds had considerable defoliant properties and of these, derivatives of the endoxohydrophthalic acids and the chlorinated phenoxyacetic acids appeared most promising from the practical point of view. Compounds of both groups were capable of inducing defoliation of some species at dosages per leaf that can be attained by aerial distribution of relatively small amounts per acre. Other compounds which cause defoliation included the phytotoxic chloro and nitrophenols, ammonium trichloroacetate and certain halogenated benzoic acids.

95. Some of the effective compounds were investigated in more detail. It was found that the addition of a surface-active agent to water solutions of disodium 3, 5-endexohexahydrophthalate increased its activity, but that further addition of ammonium sulphate, glucose or glycerol, which had been suggested as activators, did not enhance this effect. In one experiment, this defoliant appeared to be translocated. A comparison of the 4-chloro, 2, 4-dichloro, 2, 4, 5-trichloro- and 2-methyl-4-chloro-derivatives of phenoxyacetic acid in various formulations showed no large differences, but there was a trend for the ester formulations to be most effective. Dosage-response relationships were investigated and with the chloro-and nitrophenols it was possible to obtain supraoptimal dosages at which the degree of leaf fall was no greater or even small than at lower dosages.

96. One of the striking features of the experiments was the considerable variation in the susceptibility of different woody species to each of the possible defoliants. This variability was confirmed by the results of spraying small mixed thickets with disodium, 3, 6-end-oxohexahydrophthalate and butyl 2, 4, 5-trichlorophenoxyacetate.

97. A further series of experiments is now being conducted.

98. The Committee wish to record their indebtedness to Professor Blackman and his team at the Department of Agriculture, University of Oxford, for facilitating and directing their work.

PART IV. INSECTICIDES, FUNGICIDES AND HERBICIDES RESEARCH NOT UNDER THE AUSPICES OF THE COMMITTEE

99. The Committee wishes to draw attention to some of the research which is being done in or on behalf of the Colonies without the assistance of the Committee. These notes are not comprehensive; they cover only those projects which are thought by the Committee to be of exceptional interest.

British Guiana

100. Investigations are being made into methods of control of the Acoushi ant, *Atta cephalotes* L. Successful control, which often involved one or two retreatments in the case of large nests, was obtained by the use of parathion, methyl bromide and chlordane. All insecticidal treatments were considered economic. It was concluded that parathion and methyl bromide would probably be of most value

when used by organized extermination teams while chlordane could be used by small farmers directly. The rodenticide Warfarin has been tested and found to be most successful for the control of field and house rats.

Fiji

101. Trials of modern insecticides and applicators continued and DDT sprays gave excellent control of the rice leaf hopper, *Sogata furcifera*, in seed beds. Dusting or spraying with DDT was very effective against Taro leaf hopper, *Tarophagus preserpina*. Chlordane emulsion sprays gave complete control of ground-nesting ants in the field and around houses and eliminated ground pests, including fly maggots and mites from mushroom beds. A new American insecticide " Compound 497 " has given very good results against cockroaches. " Takitak " a tropical tanglefoot made in England has proved effective as a band for the trunk of coconut palms, preventing ants, stick insects and other wingless insects from ascending the palms. DDT dusts have given excellent control of cabbage grubs.

102. Parasites have been introduced from Hawaii for the control of army worm in rice and pastures, because *Cirphis unipuncta* causes considerable damage and losses in rice and its control by paris green baits has not been entirely satisfactory. The parasites have established themselves throughout the rice growing areas and already it seems certain that this biological control measure is an unqualified success.

Gold Coast

103. Entomological work has been largely devoted to the stalk borers attacking cereal crops. The Entomologist made a major revision of the systematics of the African species of *Sesamia* in which 25 species belonging to six genera have been described.

104. Work is being done on the bionomics and control of *Sesamia* (two species), *Busseola fusca* Fuller, *Eldana saccharine* Walker and *Proceras ignefusalis* Hampson. Particular attention has been focussed on the alternate-host aspect of control and there are strong indications that it might be desirable to abandon the use of elephant grass (*Pennisetum prupureum* Schum) as a fallow crop, particularly in areas where *Sesamia* occurs. Good control of the latter borer has been achieved with BHC dusts and a small-scale extension programme of borer control by these means is contemplated for 1952.

105. *Oecophylla* species are among the common ants harboured by citrus trees and they can be a considerable nuisance to the pickers when citrus is being harvested as they inflict painful bites. It has been shown that both DDT and BHC sprays will control this ant. Parathion is even more effective than either but is ruled out as a practical proposition under West African conditions on account of its toxicity. Population counts have shown that maximum activity occurs at a temperature of 80° F. and that, to achieve maximum contact with sprays, spraying should be done when temperatures are at this level.

106. *Herbicides.* Small scale trials have shown that burr-weed *Acanthospersum hispidum* DC. can be killed either by dusting the plants with 2,4-D dust at the rate of 0.6 lb. per acre, or by spraying with a solution of Na 2,4-D applied at a rate equivalent to two lb. of the salt per acre. It is planned to try out these herbicides on a more extended scale, and depending on the result, an all-out drive may be made to eradicate the weed from market places where it usually grows in profusion.

107. Investigation has continued into the use of a systemic insecticide for the control of mealy bugs on cocoa.

Kenya

108. The beneficial effect of " Tonic copper spraying " in reducing leaf fall and die-back and increasing coffee yields has been shown to be due to a fungicidal action of the copper and not to a nutritional effect. Comprehensive experiments are in progress to determine the best time to spray in various districts, together with optimum concentrations, rates and methods of application of spray.

109. A number of experiments has been conducted to test various materials for the protection of stored grain against insect damage. BHC has proved most effective and the use of BHC in foodstuffs up to a maximum of one part per million in the form of a diluted dust is now permitted, this dosage being below the United Kingdom permissible limit but above the effective control limit. Pyrethrum is effective under conditions of relatively high humidity but only confers temporary control, under dry conditions. Pyrethrum preparations containing synergists are still under investigation. Experiments on the protection of maize cobs in crib stores used on farms, are just beginning.

110. Work has continued on the survey of *Simulium neavei* and its control with DDT. Experiments are being conducted on the control of *O. moubata* with Gammexane. Residual spraying of houses with DDT has controlled *A. aegypti* on the coast.

Northern Rhodesia

111. Experiments continue with the use of BHC, DDT and toxaphene for tick control in dips, sprays and by fogging. The use of BHC and DDT combined appears to give the best results.

112. Comparisons have been made of the effects on eelworm of DDT, Dowfume and methyl bromide

(*a*) on the eelworm population of the soil,

(*b*) on the growth and quality of tobacco grown in soil heavily infected with eelworm and treated with these fumigants.

113. At Lusaka a series of laboratory experiments is being conducted on seed tobacco treatment and sprays.

Seed treatment. Assessing the efficacy of treating seed with a mercurial compound possessing growth-producing hormones. The object is two-fold (*a*) the prevention of disease and (*b*) the production of sturdier seedlings for transplanting in a shorter time than normal.

Fungicidal Spray. Assessing the efficacy of Phenyl Mercury Fixtan for (*a*) the prevention and (*b*) the control of frog-eye and alternaria.

Virucidal Spray. Assessing the efficacy of " Virucide 5 " against mosaic and other virus diseases such as leaf curl, rosette and kromnek.

Tsetse Control

114. During 1951 an entomologist carried out a number of surveys in order to determine the practicability of applying insecticidal measures as a means of tsetse control. In an area near Broken Hill there exists a large pocket of fly which constitutes a permanent threat to the surrounding country. After a comprehensive investigation into the limits of the infestation and the general ecology of the region, the entomologist has formed the view that discriminative clearing would in fact be the most economic means of control, though any fly that remained after clearing might have to be eliminated by insecticides. A similar investigation of a small area on the south-west shore of Lake Tanganyika indicates that successful control might be achieved by insecticides, using a " Fog Dispersal " unit. This possibility is being further pursued.

Tanganyika

115. An entomologist has been investigating white coffee borer control by main-stem applications of certain formulations of DDT, BHC, toxaphene and dieldrin, with gum-rosin stickers; the predators of green scale (*Coccus africanus*) and attendant ants; and the control of green scale by dieldrin, toxaphene, parathion and white oil emulsion. Insecticidal control of sisal weevil is under investigation with Pest Control Ltd.

116. In confirmation of earlier work at Ilonga it was demonstrated that 10 per cent. DDT plus three per cent. BHC, with talc filler, was effective in controlling American Bollworm and Stainer. Spraying trials were carried out by Messrs. Pest Control Ltd. in collaboration with the scientific staff of the Station. Plans have been made for fairly large-scale dusting in the Province during 1952.

117. During the year benzene hexachloride dipping tanks have been installed in two districts and have shown the value of the policy of having compulsory dipping, in conjunction with hand-dressing and spraying, the latter method of control being preferable under certain conditions.

Zanzibar

118. It has been shown that *Theraptus* sp., a Coreid bug, causes premature nut fall and severe gummy distortion in the fruits of coconuts and that a natural predator of this pest, *Oecophylla longinoda*, is driven from the palms by other ants, *Anoplolepis longipes* and *Pheidole megacephala*, which do not themselves parasitize *Theraptus*. Where *Oecyphylla* is not present coconut yields are very considerably reduced. These observations were made by the entomologist of the Clove Research team who investigated the problem at the request of the Department of Agriculture. Further investigations into the control of *Theraptus* either by the application of insecticides or by the re-introduction of *Oecophylla* are being undertaken by a Protectorate entomologist.

APPENDIX

Papers published or circulated to the Committee

PUBLISHED

Studies on Aqueous Suspensions of Insecticides, Part II, by F. Barlow and A. B. Hadaway. (Bulletin of Entomological Research, Vol. 42, 1952, pp. 769-777).

Sorption of Solid Insecticides by Dried Mud, by A. B. Hadaway and F. Barlow. (Nature, Vol. 167, 1951, p. 854).

Some Factors Affecting the Availability of Contact Insecticides, by F. Barlow and A. B. Hadaway. (Bulletin of Entomological Research, Vol. 43, 1952, pp. 91-100).

Distribution and Fate of *A. gambiae* and *A. funestus* in Two Different Types of Huts Treated with D.D.T. and B.H.C. in Uganda, by P. R. Wilkinson. (Bulletin of Entomological Research, Vol. 42, 1951, pp. 45-54).

Studies on Aqueous Suspensions of Insecticides, Part III, by A. B. Hadaway and F. Barlow. (Bulletin of Entomological Research, Vol. 43, 1952, pp. 281-312).

IN THE PRESS

Physical Factors Affecting the Efficiency of Insecticides, by A. B. Hadaway and F. Barlow.

Experiments on the Effect of Residual Insecticides in Houses against *A. gambiae* and *A. funestus,* by G. Davidson.

CIRCULATED

The Influence of Surface Hardness upon the Toxic Efficiency of Insecticides in Urea-Formaldehyde Resin Coatings, by A. P. Bracey.

Some Preliminary Meteorological Observations in East Africa on Aerosol Behaviour, by D. Yeo.

A Short Note on (Tsetse) Fly Movement, by D. Yeo.

The Deposition of Aerosols upon Tsetse Flies and Some Screening Effects of Vegetation, by D. Yeo.

Statistical Variations in Dosage, by D. Yeo.

Insecticidal Surface Coatings: 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.

Wind Tunnel Experiments at Rothamsted, by D. Yeo.

Eddy Velocities in the Atmosphere, by D. Yeo.

Brief Report on Trials of Drugs and Insecticides for the Treatment and Control of Malaria, by the Institute for Medical Research, Kuala Lumpur, Malaya.

Comparative Anopheline Larvicidal Properties of D.D.T., Dieldrin and Aldrin, by H. C. M. Parr.

Interim Report on Experimental Aircraft Application of Mosquito Larvicides at Dar-es-Salaam, by D. Bagster-Wilson.

Summary of Entomological Work conducted in 1951 by the team of the Mauritius Malaria Eradication Experiment.

Boom Installations in the Experimental Ansons, by the Colonial Insecticide Research Unit, E. Africa.

Experiments on the Effect of Climatic Conditions in Bush Country on Aircraft Spraying of Insecticides, by B. W. Thompson.

Aerial Spraying against Tsetse Flies in E. Africa, IV. Aerosol Applications at Kikore, September, 1950—June, 1951.

Study of the Position regarding Plant Diseases in Colonial Empire and Other Tropical and Sub-Tropical Territories and the Possibilities of their Control, by S. P. Wiltshire.

The Development, Installation and Testing of the S.A.3. (Spray) and E.A.2. (Exhaust Smoke) Equipments fitted in Anson I Aircraft for the Dispersion of Insecticides, by R. F. Hill. (Porton Technical Paper, 214).

The Development and Testing of the S.A.4. (Spray) Installations fitted in an Avro XIX aircraft for the Dispersion of Insecticides, by R. F. Hill. (Porton Technical Paper, 242).

Report on the Drop Spectrum produced by an Insecticide Oil Solution when sprayed from an Avro XIX Aircraft fitted with the S.A.4. Installation. (Porton Technical Paper, 253).

The Use of Selective Herbicides in the Overseas Food Corporation Areas of Tanganyika: Summary of Report on Experimental Work, 1950.

Colonial Economic Research Committee Fifth Annual Report (1951-1952)

The London School of Economics and Political Science,
Houghton Street,
Aldwych, W.C.2.
23rd June, 1952.

SIR,

I have the honour on behalf of the Colonial Economic Research Committee to transmit to you the fifth report of the Committee covering the period from 1st April, 1951, to 31st March, 1952.

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
FIFTH ANNUAL REPORT
(1951–1952)

Membership

PROFESSOR SIR ARNOLD PLANT, Professor of Commerce, University of London, *Chairman.*

PROFESSOR S. H. FRANKEL, D.Sc. (Econ.), Professor of Colonial Economic Affairs, 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 Administration, 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.

COLONIAL ECONOMIC RESEARCH COMMITTEE

CONTENTS

FIFTH ANNUAL REPORT

I. INTRODUCTORY

1. Much of the Committee's business during the year was conducted by correspondence and in informal discussions between members, and only one meeting was held.

2. The following changes in the membership of the Committee were made. Professors Tress and Sayers and Mr. Stone were invited to become members of the Committee, Professor A. J. Brown and Mr. Hall resigned owing to pressure of work, and it was decided to release Mr. Glenday, Mr. Campion and Mr. Stafford from the obligation to attend all meetings and to invite them in future to attend in a personal capacity whenever it was felt they could assist in discussions. It was also decided to discontinue the Advisory Panel on National Income Studies.

II. GENERAL

3. The Committee experienced the greatest difficulty in finding suitably qualified candidates to undertake research: but towards the end of the year it proved possible to make a number of economic appointments to the regional Institutes. The recruitment of senior economists for short-term research appointments still remains extremely difficult. Consideration is now being given to the possibility of research during long vacations by University staff, or to their secondment.

4. Members of the Committee were closely concerned in the selection of staff for the Institutes of Social and Economic Research. Discussions between the Directors of the West African and West Indies Institutes of Social and Economic Research and members of the Committee have taken place on research programmes and staff policy.

5. The Committee has invited Colonial Universities and University Colleges to submit schemes for economic research, and preliminary proposals have been received from the University College of the Gold Coast and Makerere College. These are now being considered.

6. The Colonial Research Council recommended that £100,000 of the funds remaining in the Colonial Development and Welfare Research allocation should be devoted to the promotion of economic research. A part of this allocation will be devoted to research conducted by institutions in the Colonies, and forward plans for the expenditure of the balance are under consideration.

III. ECONOMIC RESEARCH UNDERTAKEN DURING THE YEAR

7. Dr. Ida Greaves' monograph on *Colonial Monetary Systems* was received and submitted to her supervisory Committee, which has recommended its publication in the Colonial Research Studies series. Publication now awaits a few revisions to the final draft.

8. Professor Gilbert Walker's report on the *Economics of Transport in Nigeria* is in active preparation.

9. A report on the value of *market surveys* as an aid to the promotion of industrial development was presented to the Secretary of State by the British Export Trade Research Organization.

10. Dr. P. T. Bauer's study of the *structure and organization of trade in West Africa* had almost reached completion at the end of the year under review.

11. The *Nigerian National Income Survey*, which is being carried out for the Colonial Office by the Department of Applied Economics of the University of Cambridge, made considerable progress during the year. Dr. Prest made a brief visit to Nigeria in the summer and Mr. Stewart made a further tour in the Northern Province and the Western Province, accompanied for a part of the time by Mr. Lardner.

The investigators have now visited all provincial headquarters and about 80 per cent of divisional headquarters to collect all possible economic information in official records, and have maintained contact with sociologists working in the area whose intensive local studies have been of value to the inquiry. Trading firms and missions have supplied information. Since the early part of this year, the work of organizing the material and making the computations has begun, and it may be that the material will be in publishable form by the end of 1952. Consideration is being given to publishing the results of the inquiry in two forms, a detailed report to be issued by the Colonial Office and a simplified one for the benefit of the general public by the Government of Nigeria.

IV. PUBLICATIONS

12. The following list of publications is based on economic research assisted by Colonial Development and Welfare grants:—

BAUER, P. T.—(1948) " Report on a Visit to the Rubber Growing Smallholdings of Malaya ". *Colonial Research*, Publication No. 1, H.M.S.O.

BAUER, P. T. (with YAMEY, B. S.)—(1951) " Economic Progress and Occupational Distribution ". *Economic Journal*, Vol. LXI, No. 244.

BAUER, P. T. (with YAMEY, B. S.)—(1952) " Competition and Prices: A Study of Groundnut Buying in Nigeria ". *Economica*, Vol. XIX, No. 73.

DEANE, PHYLLIS M.—(1947) " Problems of Social Accounting in Central Africa ". *Human Problems in British Central Africa*, No. IV.

——(1949) " Problems of Surveying Village Economies ". *Human Problems in British Central Africa*, No. VIII.

GREAVES, IDA C.—(1950) " Colonial Currencies and Foreign Exchange ". *Crown Colonist*, Vol. 20, No. 226.

——(1950) " What the Amount of Money Means ". *West Africa*, No. 1722.

——(1951) " What can a Central Bank do for a Colony ? " *West Africa*, No. 1803.

——(1951) " Money and Currency in the West Indies ". *Journal of the Barbados Museum and Historical Society*, Vol. 18, Nos. 3 and 4.

——(1951) " The Sterling Balances of Colonial Territories ". *Economic Journal*, Vol. LXI, No. 242.

——(1952) " Colonial Sterling Balances: the Facts ". *New Commonwealth*, Vol. 23, No. 2.

LEUBUSCHER, CHARLOTTE—(1947) " The Cocoa-Processing Industries ". *Bulletin of the Imperial Institute*, Vol. XLV, No. 3.

——(1948) " The Processing of Copra, Oil Palm Products and Groundnuts ". *Bulletin of the Imperial Institute*, Vol. XLVI, No. 1.

——(1948) " The Processing of Sisal and the Manufacture of Sisal Goods ". *Bulletin of the Imperial Institute*, Vol. XLVI, Nos. 2–4.

——(1950) " The Processing of Sugar Cane and of Cane Sugar ". *Colonial Plant and Animal Products*, Vol. I, No. 1.

——(1951) " The Processing of Colonial Raw Materials: A Study in Location ". *H.M.S.O.*

PREST, A. R.—(1952) " The National Income of Nigeria ". *West Africa*, No. 1820. —(1952) *West Africa*, No. 1821.

Tsetse Fly and Trypanosomiasis Committee Report for 1951-1952

The Church House,
Great Smith Street,
Westminster, S.W.1.
26th June, 1952.

SIR,

I have the honour to transmit to you the Report of the Tsetse Fly and Trypanosomiasis Committee for the year ended 31st March, 1952.

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 1951–1952

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. C. A. HOARE, F.R.S., Of the Wellcome Laboratories of Tropical Medicine.

DR. E. M. LOURIE, M.B., D.P.H., Chief, Section of Biological Standardization, World Health Organization.

DR. L. HARRISON MATTHEWS, M.A., Scientific Director of the Zoological Society of London.

COL. H. W. MULLIGAN, M.D., D.Sc., Director, West African Institute for Trypanosomiasis Research.

SIR COSMO PARKINSON, G.C.M.G., K.C.B., O.B.E., Formerly Permanent Under-Secretary of State, Colonial Office.

MR. W. S. BATES, (*Secretary*).

Ex-Officio Members

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 Secretary of State for Commonwealth Relations. A representative of the Sudan Government.

It is the practice to invite a member of the National Institute for Medical Research and the Central African Scientific Liaison Officer 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 1951–1952

CONTENTS

TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE

REPORT FOR 1951 - 1952

PART I. MEMBERSHIP OF THE COMMITTEE

Sir Andrew Cohen, K.C.M.G., O.B.E., who had presided over the meetings of the Committee for more than four years, relinquished the Chairmanship when he left the Colonial Office in December, 1951 to take up his appointment as Governor of Uganda. Mr. W. L. Gorell Barnes, C.M.G., the Assistant Under-Secretary of State in charge of the African Division of the Office, has been appointed Chairman of the Committee and of the Sub-Committee on Game.

2. Dr. H. M. O. Lester, O.B.E., who has held the post of Director of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization since its inception in 1948, has been appointed Director of Medical Services, Federation of Malaya, and has in consequence ceased to be a member of the Committee. The Committee has paid tribute to the excellent work which has been accomplished at the Organization and in the field of tsetse and trypanosomiasis research and reclamation generally in East Africa during the period of Dr. Lester's Directorship.

3. Dr. E. M. Lourie has accepted the appointment of Chief of the Section of Biological Standardization at the World Health Organization. Although he will now be working in Geneva, Dr. Lourie has agreed to remain a member of the Committee and his expert advice on pharmacological matters will thus continue to be available.

PART II. THE EAST AFRICAN TSETSE AND TRYPANOSOMIASIS RESEARCH AND RECLAMATION ORGANIZATION

Introductory

4. The programme of work of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization for the period 1951–56 makes provision for the continuation of the basic research which has been conducted in the last five years into tsetse and trypanosomiasis problems, and for considerable extensions in the field of animal trypanosomiasis. It aims at applying the results of research increasingly to large scale field trials in experimental reclamation. It provides for pilot schemes of practical reclamation in conjunction with approved programmes of settlement and land utilization, and for a further development of advisory services throughout East Africa.

5. Preparatory work in connection with the building of the Central Trypanosomiasis Research Institute has progressed satisfactorily. The Government of Uganda has assigned 1,746 acres of land at Sukulu to the Organization for the laboratory and ancillary buildings, and housing plots for six European houses in the Tororo township have also been allocated to the Organization. The land at Sukulu has been surveyed and fenced. A start has been made with the building of the houses, and tenders have been invited for the construction of the laboratory and other buildings. Building costs in Uganda have risen and are still rising. It will be necessary, therefore, to make full use of the facilities existing at Tinde so as to confine the building requirements at the new institute to a minimum. Some of the staff originally earmarked for Sukulu may now have to be posted permanently to Tinde, or at least stationed for a considerable proportion of time at that station.

6. Staff for the Central Trypanosomiasis Research Institute is being recruited and a number of appointments have been made. These officers will be engaged

temporarily at centres or field stations where facilities are available for trypanosomiasis research, such as at Tinde in Tanganyika, at Kabete or Mariakani in Kenya, or Entebbe in Uganda.

Trypanosomiasis Research

7. A general programme of research into human trypanosomiasis has been prepared. The long term experiment of maintaining *T. rhodesiense* in animals with periodical tests of the infectivity to man will continue as heretofore. The latest test (November to December 1951) showed a sharp drop of infectivity to man. This is consistent with expectation from the type of long term cyclical variation which had been observed so far. These tests extend to seventeen years, a period over which *T. rhodesiense* maintained in sheep by fly passage has retained its ability to infect man. One of the purposes of the original Tinde experiments thus appears to have been proved conclusively—namely, the stability of the property of infectivity to man. Another problem for investigation was on the relationship between *T. rhodesiense* which causes Rhodesian sleeping sickness, and *T. brucei*—an almost indistinguishable trypanosome of game and domestic animals. A scientific article on the relationship of these trypanosomes was published by Culwick, Fairbairn and Culwick. It raises points of major importance. The continuation of the work with other strains of the two species is provided for as soon as staff become available.

Antrycide Research

8. Animal trypanosomiasis presents a rich field for research, both of fundamental and practical importance. Until the facilities of the Central Trypanosomiasis Research Institute are available the full programme of research cannot be implemented. The Colonial Development and Welfare scheme No. R. 318 made in 1948 has however enabled the prophylactic and curative properties of antrycide to be investigated by means of experiments carried out in conjunction with the East African Veterinary Research Organization.

9. Experiments under this scheme show that, while antrycide is a most useful curative drug of trypanosomiasis of cattle, it is far from being infallible for all stages of the disease. It is very effective against the acute stages of *Trypanosoma congolense* and *T. vivax*. In the chronic stages of the disease a single injection is not fully effective against either trypanosome.

10. The continuation of protective doses of antrycide mixture at monthly and two-monthly intervals to groups of cattle exposed to constant attack by *Glossina austeni* proved to be disappointing. These frequent doses failed to produce a durable and sterile prophylaxis. Evidence of late appearance of trypanosomes in the blood, a picture of anaemia in the blood, tissue changes at autopsy and the demonstation of trypanosomes in the heart, lung and kidney indicated that the protection given by antrycide was not absolute. The drug had evidently acted as a suppressant not a prophylactic. Cryptic infection of treated cattle exposed to fly for long and for short periods was demonstrated by injecting animals with attenuated rinderpest goat virus, and later with T.A.B. vaccine and adrenalin. Cattle from which smears had always been negative proved to be infected when so injected. It has been shown that drug-fast trypanosomes appear with " relapses " after treatment, and that a measurable increasing resistance to antrycide develops. At Kiboko in Kenya, it was shown that drug-fast trypanosomes may become dominant in the tsetse population and persist for as long as seven months. It is therefore concluded that improper use of antrycide as a prophylactic may lead to the dissemination of trypanosomes, fast both to antrycide and to dimidium bromide. Under proper use as at Mariakani (also in Kenya), where injections were given at monthly and at two-monthly intervals, antrycide as a prophylactic was shown not to be dangerous from the aspect of transmitting drug-fast trypanosomes for a

period of twelve months. Cattle so treated, however, seem to harbour cryptic infection and should be marketed and slaughtered rather than be allowed to return to clean grazing grounds where infection might be spread by biting flies other than tsetses.

Tsetse Research

11. In the field of tsetse research only one fly—a *G. pallidipes*—has been caught in the game experimental blocks at Shinyanga; and clean cattle kept in the area for eleven months have remained healthy and free from trypanosomiasis. The game destruction reported in the 1950 annual report has led to the elimination of *morsitans* and *swynnertoni* in these isolated blocks of bush. It is stressed, however, that without effective isolation such blocks of bush freed from fly by game destruction might readily become reinfested.

12. Studies of fly populations have been continued at Shinyanga and in field stations, and earlier anomalous results have now been explained. These studies have been extended to species other than *morsitans* and *swynnertoni* and now include *pallidipes*, *palpalis* and *austeni*.

13. Improved fly round techniques have increased catches of female flies; and freshly marked flies have helped to locate concentration sites at Shinyanga. Important observations have been made on pupal sites of *morsitans*, *swynnertoni* and *pallidipes*, on the production of normal populations of tsetse in the laboratory, and on the behaviour of flies under selected sets of conditions in the laboratory. Further progress has also been made in the collection of material for the production of antisera for the Lister Institute, and in the identification of animals by this method, on which tsetse populations depend for their survival.

Experimental Reclamation

14. Further advances have been made during 1951 in experimental reclamation and, particularly, in the interpretation of data collected in the course of investigations conducted concurrently with practical measures of tsetse control. It is possible, for instance, to distinguish the components of tsetse habitats by fly catches, and by the type, density and zonation of the vegetation. This gives greater precision to the demarcation of areas essential to the fly, and which need to be cleared of bush as a first step in tsetse control. It also points to simpler and cheaper methods of control which can be employed with early settlement.

15. The experimental reclamation of some 100 square miles near Tabora township has progressed satisfactorily. Despite shortage of labourers additional areas have been made fly free, thus safeguarding Tabora and enabling the development of a pasture research station and of an experimental farm, as well as of many square miles of native reserve.

16. The game drive as an initial step to eradicate *G. pallidipes* from the Lambwe Valley experimental area was abandoned early in 1951. Foci of fly concentrations on cultivable land to be cleared by new settlers were demarcated; and incentive clearings on uncultivable infested land were made by the Organization. Settlement of the first block of land has begun. Dams have been made and holdings have been marked and contoured.

17. A technique for locating primary foci of *pallidipes* has been discovered, and some of these have been cleared of bush in order to find what part they play in the general infestation. Studies of the breeding sites and seasonal shifts of the fly population in the Lambwe are proving to be of interest and value in connection with survey technique and with reclamation by bush clearing.

Survey and Advisory Services.

18. The Organization's survey and advisory services continue to be used increasingly by the East African Governments. Surveys have been undertaken in the Kilombero Valley in connection with the proposed Central Africa rail link; in the Songea district of Tanganyika; in Zanzibar; and in Uganda where outbreaks of trypanosomiasis have been reported from time to time. In Kenya advice has been given on the relation of the coastal vegetation and fly infestation.

19. Surveys and investigations were also made preparatory to putting forward proposals for three pilot schemes of practical reclamation, one in each of the three territories. Detailed plans and estimates were drawn up and were approved by the Governments of Kenya, Uganda and Tanganyika. On the recommendation of the Tsetse Fly and Trypanosomiasis Committee, grants totalling £200,000 were made available from Colonial Development and Welfare funds to finance these projects. Each of the Governments concerned has undertaken to utilise beneficially and to develop the land reclaimed under these pilot schemes.

PART III. THE WEST AFRICAN INSTITUTE FOR TRYPANOSOMIASIS RESEARCH

Introductory

20. The original building programme at both Kaduna and Vom has been completed, all necessary services have been installed and, except for some furnishing of special design for the library and museum and a few items of highly specialized equipment which have not yet come forward, the laboratories have been fully equipped in accordance with the original plan.

Some changes in senior service personnel have been necessitated by transfer and invaliding but, at the present time, there is a full complement of expatriate staff.

21. The primary function of the Institute is to undertake research, in the laboratories and in the field, on all aspects of human and veterinary trypanosomiasis. The Institute has no responsibility for the actual conduct of trypanosomiasis control measures but it serves as a clearing house for information about trypanosomiasis, as an advisory bureau and as a centre for the training of expert personnel. Close liaison is maintained with organizations and departments concerned with the control of trypanosomiasis in man and domestic stock and, in scientific matters, with the Tsetse Fly and Trypanosomiasis Committee, the International Scientific Committee for Trypanosomiasis Research, and the Scientific Council for Africa South of the Sahara. The Director is a member of each of these three scientific bodies.

22. Although research work was commenced while the building programme was still in progress, full facilities have become available only during the past year. A brief account of these activities is given below.

Entomology Research

23. The task of establishing a tsetse-breeding colony in the laboratory, designed to satisfy all the needs of the Institute, has been undertaken by the Entomology Section and has been accorded the highest priority. A special insectary has been set up which is air-conditioned by improvised methods and which has so far proved satisfactory. Special staff has been trained and various methods are now being tried out. This work has absorbed a large proportion of the time of the Chief Entomologist and his staff but, at the same time, it has yielded a great deal of information concerning the ecological requirements of tsetse. Considerable progress has already been made in the large-scale rearing of tsetse-flies and the prospects are that at least 1,000 pupae a month will shortly be available for experimental work.

24. For several years careful observations have been made in the field on the ecology of the important riverine species, *G. palpalis*, and an enormous amount of data has been accumulated. This has recently been subjected to detailed analysis and the results are now in course of preparation for publication. It is not possible to summarize this work.

25. Meanwhile an opportunity has arisen to begin field studies on the woodland species, *G. morsitans*, in connection with the Mokwa development scheme in Northern Nigeria. These are the first studies to be undertaken in West Africa on this widespread and highly dangerous species with the primary object of evolving ways and means of making newly developed areas sufficiently safe for the introduction of livestock.

26. It has recently come to light that *G. morsitans* has made serious advances in the Zaria Province of Northern Nigeria and other Provinces are threatened with invasion. In this connection, Dr. T. A. M. Nash, Chief Entomologist, has analyzed all available data and has clearly shown that there is a serious threat to large tracts of country including the Anchau Corridor which has remained tsetse-free since the completion of the well known Anchau Resettlement Scheme. Dr. Nash's report on this new development has been submitted to the Government of the Northern Region of Nigeria and an active campaign has already been launched to arrest this serious menace.

27. It is proposed, in future, to devote considerable attention to the study of the little known species of tsetse in high forest areas and for this purpose to open a new field station in a suitable locality at the earliest opportunity. Preliminary observations have yielded results of great interest which suggest that future studies are likely to be of considerable economic importance. By the introduction of a new survey technique, Dr. Nash has already shown that certain high forest species, hitherto regarded as extremely rare, are not only prevalent but potentially dangerous. Dr. Nash's new technique has been also applied to the study of *G. morsitans* and has yielded information that could not have been obtained by older methods. Two papers dealing with the results obtained by this new method have been prepared for publication.

28. A long-term experiment to determine the degree of erosion, if any, which follows cleaning of tsetse-infested streams has been continued.

29. In addition to the laboratory experiments being carried out in connection with large-scale tsetse breeding, a study of the factors governing the selection of sites for the deposition of tsetse larvae is in progress.

30. Further work on the systematics and distribution of tsetse-flies in West Africa has been undertaken. There is reason to believe that at least one new species of tsetse has been collected from the British Cameroons. The heavy task of preparing a comprehensive tsetse map of Western Africa has been completed and the details have been incorporated in the " All-Africa " Tsetse Map shortly to be published.

Epidemiology Research

31. Investigations on the epidemiology of human sleeping sickness have been continued in the field and during the year Dr. Hutchinson commenced a new investigation in the Gambia. Further analyses of existing records have also been made. The results of this work are being carefully recorded in both manuscript and cartographic form with a view to the publication of a comprehensive monograph on the epidemiology of human trypanosomiasis. On completion of the work in the Gambia it is proposed to investigate the epidemiology of human trypanosomiasis in the high forest terrain where tsetse-flies are known or believed to be prevalent but where the indications are that sleeping sickness is absent or uncommon.

32. In the laboratory work has been continued on the isolation of strains of *T. gambiense*, the cause of human sleeping sickness in West Africa, and on the maintenance of these strains by cyclical transmission through tsetse-flies. This work is fundamental to further studies on the human disease and to the accurate assessment of the value of drugs for curative and prophylactic use.

33. Material has been collected by biopsy and at post-mortem with a view to undertaking a thorough investigation of the pathology of trypanosomiasis in both man and animals. The evolution of improved diagnostic methods, especially for cryptic infections, is also receiving attention and experiments are currently in progress with a new culture medium prepared and supplied by Dr. N. Weinman of Yale University.

Chemotherapy and Chemoprophylaxis.

34. The synthesis of trypanocidal compounds is a task for which the Institute is neither staffed nor equipped, and progress in the chemotherapy and chemoprophylaxis of both human and animal trypanosomiasis is, therefore, dependent on the preparation of new compounds in Europe or America. The assessment of the value of curative and preventive drugs both in the laboratory and in the field is, however, well within the competence of the Institute staff and occupies a considerable proportion of their time.

35. Difficulty was formerly experienced in evaluating certain drugs owing to variations in the toxicity and therapeutic efficacy of different batches of the same drug. It has now been arranged for drugs to be selected, prepared and standardized before being recommended for field trials in Africa and it is hoped that under these arrangements it will not only be possible to obtain consistent results with any given drug but that comparisons will be possible between the results reported from various territories. A supply of a standardized batch of Melarsen has recently been received from the United Kingdom and its curative reaction in human sleeping sickness is now being investigated. A supply of Msb to be tested as a prophylactic in human trypanosomiasis is expected shortly and when received it will be subjected to trial in parallel with pentamidine. An experiment of the prophylactic value of pentamidine in human trypanosomiasis has recently been commenced in a circumscribed locality near Kaduna with a population of approximately 4,000.

36. Antrycide methyl sulphate, made available to the officers of the Veterinary Services for curative purposes, has been used on a considerable scale and the results reported have been uniformly good.

37. Antrycide prophylactic mixture, now marketed as " pro-salt," has been carefully investigated in the laboratory and in the field and the results so far obtained indicate that this drug, when administered at intervals of ten weeks, may be expected to afford a high degree of protection to cattle maintained in contact with riverine tsetse (*G. palpalis*) but that it cannot be relied upon to protect cattle exposed to the more severe challenge from the woodland species *G. morsitans*. The results of two large-scale field experiments on the use of Antrycide as a prophylactic have been submitted for publication.

38. In collaboration with the Nigerian Veterinary Department, Mr. K. Unsworth, Chief Veterinary Research Officer, has investigated the use of Antrycide prophylactic mixture for the protection of trade cattle. In a carefully planned and well supervised experiment it has been shown that Antrycide pro-salt affords a high degree of protection to trade cattle traversing tsetse-infested localities on their way to market. In this experiment cattle proceeding on the hoof from Kano to Ilorin, and later to Ibadan, remained completely free from trypanosomiasis while all the untreated cattle accompanying them became infected and several died. There was an average weight gain of 13 kilos per head in the treated group as

against an average loss of 11 kilos per head in the untreated animals. The results of these experiments have been submitted for publication.

39. Dr. L. G. Goodwin of the Wellcome Tropical Medical Research Laboratories, London, worked at the Institute for the first six months of 1951 on the therapeutic and prophylactic value of four new phenanthredinium compounds. These drugs, which had shown great promise when tested against syringe-passaged strains of *T. congolense* in mice in the United Kingdom, were tried out at Vom laboratories and in the field against tsetse-passaged strains of *T. vivax* in Zebu cattle. Two of the compounds showed satisfactory curative action, and although local reactions were more severe than those produced by Antrycide, no evidence of generalized dermatitis or photosensitization was observed under local conditions. One of the compounds (150 C 47) was shown to have a powerful prophylactic action but was found to be highly toxic to cattle in the doses given. A short paper describing these new compounds and summarizing the results obtained at Vom was prepared jointly by Dr. Goodwin and Mr. Unsworth and presented to the International Scientific Committee for Trypanosomiasis Research in June, 1951.

Cattle Tolerance to Trypanosomiasis

40. In 1949 a request was received from the Nigerian Agricultural Department to undertake a pilot experiment to observe the relative tolerance of each of three groups of cattle under natural conditions in the field. The cattle were prepared and supplied by the Agricultural Department and the conditions of the experiment were agreed upon after consultation between the Agricultural Department, the Veterinary Department and the Institute. On introduction to the experimental area in October, 1949, the herd comprised 12 Zebus, 12 N'dama/Zebu crossbreds and 8 N'damas. The results of this experiment, which has now been in progress for over two years, have shown that N'dama cattle show a remarkable tolerance to trypanosomiasis even when exposed to a very severe challenge from *G. morsitans*. The true nature of this resistance, or tolerance, of N'dama cattle to trypanosomiasis is not yet fully understood but it has been clearly established that N'dama cattle will remain in good condition when exposed to a severe challenge, while Zebu and Zebu/N'dama crossbreds contract heavy and ultimately fatal infections. The results of this experiment have been submitted for publication.

Protozoology Research

41. In the Protozoology Section special attention has been paid to the study of *T. vivax*, a species of prime importance to the livestock industry in West Africa. This species has been relatively little studied in the past owing to the failure to establish strains in any of the common small laboratory animals. A determined effort was, therefore, made to overcome this serious handicap and it has now been possible to establish strains of *T. vivax* in rabbits and white rats by syringe-passage and, at the time of writing, successful transmission has been made in rabbits up to the 36th, and in rats up to the 35th serial sub-passage. This in itself may be regarded as a distinct advance, but the methods by which this success has been achieved have opened up a wide field for further investigation. It has been observed that successful passage from rabbit to rabbit, or rat to rat, can be obtained only when the inoculation of infective blood is followed within 24 hours by an injection of clean sheep or ox blood. Considerable attention has been paid to the *modus operandi* of this supplementary factor in establishing *T. vivax* infections. It has been shown that the essential factor is a property of the fluid and not the cellular elements of the blood, and attempts to isolate the essential factor from serum indicate that it probably resides in a protein fraction of the serum. These observations open up a wide field for investigation of the metabolic requirements of trypanosomes. Three papers on *T. vivax* have been submitted for publication.

42. The conditions necessary for the cyclical transmission of *T. vivax* in tsetse-flies have been investigated and it is now possible to produce, at will, batches in which a very high proportion of the flies show mature infections.

43. Colonel H. E. Short, F.R.S., Professor of Protozoology in the University of London, spent four months at the Vom and Kaduna laboratories in the early part of 1951 and carried out experiments designed to reveal a hypothetical " tissue phase " in the life history of trypanosomes in the vertebrate host. He returned to London with a collection of material for further study.

44. The above account of the Institute's research activities during the year is necessarily very superficial, but it will be seen that the research work is now covering a very wide field and that the preliminary results already obtained are rapidly opening up new fields for research.

PART IV. WORK OF THE COMMITTEE

Chemotherapy and Chemoprophylaxis

45. The Committee has continued its important function of co-ordinating the tests of various trypanocidal drugs. Mention has been made above of the trials which have been carried out in West Africa with the melaminyl compounds introduced by Dr. Friedheim and of the further experiments in both East and West Africa with Antrycide. With the co-operation of Dr. Friedheim and the National Institute for Medical Research, further steps have been taken towards ensuring the proper standardization of the Freidheim compounds. The Committee has endorsed the recommendations of a Sub-Committee of the International Scientific Committee for Trypanosomiasis Research which was set up to consider the results of experimental work in the treatment and prophylaxis of animal trypanosomiasis with Antrycide and dimidium bromide. At the same meeting of the International Committee Dr. Lourie announced the discovery of a new chemotherapeutic agent for use against *T. congolense* infection in cattle. This substance, at present known as " 528," is a chemical type that has not hitherto been used in the chemotherapy of trypanosomiasis. Tests in mice have shown that the chemotherapeutic index of " 528 " is almost the same as that of Antrycide. Sufficient quantities of the drug are being prepared to enable trials to be carried out in both East and West Africa.

International Co-operation

46. The third meeting of the International Scientific Committee for Trypanosomiasis Research was held in June, 1951 at Bobo Dioulasso in French West Africa, under the Chairmanship of Colonel H. W. Mulligan, Director of the West African Institute for Trypanosomiasis Research. The arrangements for the meeting had been made by M. le Médecin-Général Vaucel, the retiring Chairman of the Committee. The representatives of the United Kingdom, in addition to Colonel Mulligan, were Dr. E. M. Lourie, Mr. R. N, T.-W.-Fiennes of the East African Veterinary Research Organization and Mr. K. Unsworth of W.A.I.T.R. Dr. K. R. S. Morris, Director of the Department of Tsetse Control, Gold Coast, and Dr. J. L. McLetchie of the Nigerian Sleeping Sickness Service were present as observers. Mr. W. H. Potts of E.A.T.T.R.R.O. attended the meeting in the capacity of Special Rapporteur and gave an account of the progress which had been made in the preparation of a map showing the distribution of tsetse flies. Mr. Potts exhibited the draft of the first sheet of this map which was warmly received by the Committee. All three sheets are now approaching completion and it is hoped that they will be available for distribution before the end of 1952. At the invitation of the Portuguese Government, the next meeting of the Committee is to be held at Lourenco Marques in Portuguese East Africa in September, 1952.

Professor Simoes da Cruz Ferreira of the Lisbon Institute of Tropical Medicine has accepted the invitation of the Committee to act as Chairman for the session 1952–53. There is no doubt that these annual meetings provide a valuable opportunity for a general exchange of information over the whole field of tsetse and trypanosomiasis research.

47. The papers and conclusions of the 1951 meeting are being published by the Permanent Inter-African Bureau for Tsetse and Trypanosomiasis. The Bureau, which is situated at Leopoldville in the Belgian Congo has continued to discharge a valuable function by ensuring the wide dissemination of the results of research in this field. The Bureau reports that 600 copies of its publications are regularly distributed to its correspondents.

Game Research

48. In pursuance of the recommendations of the Sub-Committee on Game a Colonial Development and Welfare Scheme has been made to provide for the employment for two years of a scientist to collate the information which exists in many quarters in the United Kingdom, in various continental countries and in Africa on the mammalian fauna of Africa. A zoologist has been appointed to this post and is expected to commence work shortly at the headquarters of the London Zoological Society, where office facilities are being provided by courtesy of the authorities.

49. Because of the difficulty which the East African Governments have experienced in providing a share of the necessary funds, it has unfortunately not yet proved possible to set up a research team to investigate the scientific aspects of game problems in one particular area of East Africa. Further endeavours are being made to resolve these difficulties.

50. Towards the end of 1951, Mr. Allan Brooks, a Canadian Colonial Research Fellow, left for Tanganyika where, under the supervision of the Game Warden, he is to make a study of Thompson's Gazelle.

PART V. MISCELLANEOUS

51. The main burden of research into methods of tsetse and trypanosomiasis control falls upon the main research organizations, E.A.T.T.R.R.O. and W.A.I.T.R., which are staffed and equipped for the purpose. But at the same time much interesting and important work is being undertaken by the tsetse control departments of individual colonial territories and the following notes give some indication of the investigations carried out during the year under review.

52. In Northern Rhodesia significant progress has been made with the programme of tsetse surveys which are being financed in part by a grant from Colonial Development and Welfare (Research) funds. By the end of 1951 thirteen surveys had been completed in areas where the early definition of the limits of infestation was most urgently required. A number of surveys were also carried out in order to determine the practicability of applying insecticidal measures of control and the relative advantages of this method compared with that of discriminative clearing.

53. The Kenya Veterinary Department has carried out further investigations into delayed toxicity following the use of phenanthridinium compounds. It was shown that photosensitization in cattle given dimidium bromide is constantly accompanied by a liver lesion which is probably associated with the cause of the condition, probably due to a conditioned deficiency of an essential metabolite. The risk of toxicity following over-dosage with two other phenanthridinium compounds and Antrycide was also demonstrated.

54. The possibility of narrowing down the campaign against sleeping sickness in the Gold Coast to an attack on the disease in its true epidemic centres and on the vectors in their primary foci has made the eradication of human trypanosomiasis a practicable proposition. Since this method of focal attack is now being applied successfully in the Department's main activity, the elimination of sleeping sickness, emphasis in research during the past year has been shifted from human to animal trypanosomiasis. The process of the replacement of man by big game and *G. morsitans* in country with a population density below 15 persons per square mile came under close study during the year, and this has helped greatly in the formulation of plans for the reversal of the action and the replacement of this tsetse by settled communities of the right density and pattern. Two experiments in settlement and development in *G. morsitans* country are now providing valuable evidence. The lesson has been learned that, however desirable it may be to have settlements with systems of fixed cultivation and all the improvements this implies, the ordinary farmer, following his own methods and pursuits, is undoubtedly the most valuable agent in the reclamation of land from *G. morsitans*. The continued studies of the distribution of animal trypanosomiasis, taken in conjunction with details of tsetse incidence, are beginning to throw some light on the very important practical question of the intensity of fly which is compatible with the maintenance of healthy herds of cattle.

55. Dr. K. R. S. Morris, who for more than 20 years has played a leading part in the fight against trypanosomiasis in the Gold Coast, has recently retired from his appointment as Director of the Department of Tsetse Control. The Committee has expressed its warm appeciation of his work.

Colonial Fisheries Advisory Committee Annual Report on Fisheries Research (1951-1952)

THE CHURCH HOUSE,
GREAT SMITH STREET,
WESTMINSTER, S.W.1.
11th July, 1952.

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 1951–52.

I have the honour to be,
Sir,
Your most obedient Servant,
(Signed) H. HOPKINSON,
(Chairman).

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

COLONIAL FISHERIES ADVISORY COMMITTEE

Membership

THE MINISTER OF STATE FOR COLONIAL AFFAIRS (*Chairman*).

MR. C. G. EASTWOOD, C.M.G. (*Vice-Chairman*).

MR. J. CROFT-BAKER, C.B.E.

DR. G. E. R. DEACON, D.Sc., F.R.S.

DR. C. F. HICKLING, C.M.G., Sc.D. (Fisheries Adviser to the Secretary of State).

MR. T. S. LEACH, M.C.

DR. C. F. A. PANTIN, Sc.D., F.R.S.

DR. G. A. REAY, O.B.E., Ph.D.

MR. F. S. RUSSELL, D.S.C., D.F.C., F.R.S.

MISS E. TREVAWAS, D.Sc.

MR. R. S. WIMPENNY, M.Sc.

PROFESSOR C. M. YONGE, D.Sc., Ph.D., F.R.S.

R. H. BURT, O.B.E. (*Secretary*).

Mr. C. N. Hooper, Dr. E. S. Russell and Mr. J. Thomson retired from the Committee during the year on the expiration of their periods of appointment. Mr. J. Morley Neale resigned on account of ill health. Mr. J. Croft-Baker, Dr. G. E. R. Deacon and Mr. T. S. Leach were appointed as new members.

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.

COLONIAL FISHERIES ADVISORY COMMITTEE
ANNUAL REPORT ON FISHERIES RESEARCH, 1951–52

CONTENTS

COLONIAL FISHERIES ADVISORY COMMITTEE
ANNUAL REPORT ON FISHERIES RESEARCH
(1951-1952)

I. STAFF

1. *Research Staff.* There is a Research Staff of 19 officers, with 14 vacancies still to be filled.

2. The recruiting position is satisfactory; and the rate of recruitment is now governed as much by the rate of progress in building laboratories and houses as by the availability of candidates.

3. *Fisheries Officers.* 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 they are not research officers, it has been considered appropriate to mention them in this report, together with some of the results which they have obtained.

4. There are 51 Fisheries Officers, of whom 42 are trained expatriate officers. There is one vacancy, which is now being filled.

II. FINANCIAL POSITION

5. The Colonial Development and Welfare Acts of 1945 and 1950 made available £140,000,000 for development and research in Colonial territories. From this sum £13,000,000 was set aside for research schemes in all fields and of the £13,000,000 approximately £1,570,800 was allotted to fisheries research. At 31st December, 1951, £1,532,500 had been allocated to 34 fishery research schemes covering all Colonial territories leaving a balance of £38,300 which, together with credits arising on cancelled or reduced schemes amounting to £136,000, gave a total balance in hand of £174,300. Commitments for new schemes and for the extension of existing schemes until the 31st March, 1956, when the Colonial Development and Welfare Acts expire, amount to £120,000, leaving a balance of £54,300.

III. REPORTS OF INDIVIDUAL COLONIAL RESEARCH STATIONS

The Inter-Territorial Fisheries Research Station at Jinja on Lake Victoria.

6. The staff is now complete and consists of a Director, Mr. R. S. A. Beauchamp, and four Scientific Officers. There are two Experimental Officers.

7. The aim of this " organization " is to assess within broad limits the maximum sustained yield that can be obtained from the various inland fisheries of East Africa. Such an assessment cannot be made empirically from fishery statistics alone. A comprehensive programme of research has therefore been started covering several aspects of lake biology; the immediate aim is to acquire an understanding of the principal factors which determine the density of fish populations in the various lakes. Thus it is as important to investigate the food of fish as it is to study the fish themselves.

8. The importance of diatoms (minute free-living single-celled plants) in the economy of the lake has been demonstrated. *Tilapia* feed directly on phytoplankton, but it has been found that they digest only the diatoms. Many molluscs and insect larvae which are eaten by fish depend also on diatoms for their food. It appears that few organisms can digest algae other than diatoms; thus the fertility of the

inland waters of Africa can, to a considerable extent, be measured in terms of diatom production. The chemical analysis of water from many sources has added to our knowledge of the factors controlling diatom production. The proportions of the various nutrients present in the water are as important in determining the kinds of algae it supports as are the absolute amounts. Cultures grown in the laboratory are helping to elucidate these problems. The growth of plankton in East African waters appears to be affected by the scarcity of calcium and of sulphate. The presence of green and blue green algae are probably a significant factor in conditioning the water for the growth of diatoms.

9. The collection of aquatic molluscs has been greatly enlarged and further ecological information obtained. The more significant developments in this line concern the parasitology of the snails with particular reference to schistosomiasis.

10. The importance of Chironomid (midges or " bloodworm ") larvae as food for *Mormyrus*, *Haplochromis* and the young of many fish has been established and progress made on the life histories of these insects. Inter-specific competition is severe and the successful establishment of many species appears to be determined to a large extent by the size and density of the swarms of adults.

11. Considerable light has been thrown on the problem of growth rate and sexual periodicity of fish living in tropical waters. The sexual cycle is determined more by the internal physiological rhythm of the fish than by the external environment. *Tilapias* given satisfactory conditions and an adequate supply of food (diatoms) grow rapidly till they reach sexual maturity in from eight to eleven months. Growth subsequently is relatively slow. Data collected on the growth rate of immature fish provide an explanation for the great variability in density and modal size of *Tilapia* populations in East African waters including dams and fish farms.

12. The regular collection of fish by seine and gill net and by trawling have indicated potential new fisheries for *Mormyrus* and *Haplochromis*. An experiment has been carried out which shows that nylon nets are likely to prove a better economic proposition than flax nets.

The Inter-Territorial Marine Fisheries Research Station at Zanzibar

13. *Staff*. The Director of the Station is Dr. J. F. G. Wheeler, and he had as his Principal Scientific Officer, Dr. F. D. Ommanney (since promoted and transferred to Singapore, see paragraph 32), with Mr. F. Williams as his assistant. The planktologist, Mr. Lambert, is leaving shortly to take up his duties, and Mr. Newell, the biochemist/hydrographer, is working at the West African Fisheries Research Institute until the laboratory is built.

14. The laboratory has not yet been built, but living quarters for the staff are being built, and in the meantime the research material obtained is being worked up in the Director's house.

15. The research vessel is the " Research," formerly on the Seychelles–Mauritius survey. Up to the end of January, 1952, 13 cruises had been completed in this vessel, and a fairly stable and efficient crew had been picked and trained. The first cruises were planned to include bottom as well as pelagic fishing.

16. It was soon apparent that greater efficiency could be gained by making separate cruises for pelagic fish using the multiple trolling methods developed chiefly in Brittany. Because of the importance attached to pelagic fish of the East African coast, most of the cruises have been of this character.

17. It would appear from the results to date that the pelagic fishes haunt the edges of the shallow marginal waters, although a slight indication of a migratory

movement might be inferred from the capture of a King Fish, a Bonito and a Yellow Fin Tuna in November at the northern entrance of the Zanzibar channel.

18. To date 15 species have been represented in the catches of pelagic fish.

The Joint Northern Rhodesia–Nyasaland Freshwater Research Station in Northern Rhodesia

19. No Director has yet been appointed, but two Scientific Officers, namely Mr. P. B. N. Jackson and Mr. E. Maxwell, have arrived. Mr. Jackson is Acting Officer in Charge. The biochemist, Mr. Harding, will work at Sierra Leone until the laboratory is built.

20. One house has been constructed and a second is being built.

21. Daily work on fish in Lake Bangweulu was started in October 1951. Seine nettings are done at each of several places along the shore at various types of bottom and environment. The fishes taken are being studied and a start has been made with a type collection of animals and plants. Information as to water temperature, size of catch, size of mesh of net, weather conditions, etc., are being recorded.

22. A laboratory is being built and it is hoped to build two research vessels, one for Lake Bangweulu and one for Lake Nyasa.

West African Fisheries Research Institute

23. *Staff.* Mr. Angus G. Taylor is Director. Two Scientific Officers assumed duty this year and two others will do so within the next three months.

24. The Institute will benefit by the temporary services of two officers appointed to other Research Institutes (namely Zanzibar and Northern Rhodesia, see paragraphs 13 and 19) which are not ready to receive them. The Marine Department has been completed.

25. *Research Vessels.* The Institute's large research trawler, the " Cape St. Mary," was delivered in Sierra Leone on the 15th July, 1951. She made her first trip on the 21st July, and five successive trips.

26. On the last trip, in September, 1951, her gear box failed near the Isles de Los, and she was towed to port. The makers accepted responsibility for the failure of the gear box, and the ship was laid up until the 18th April, 1952, when she undertook her first cruise after installing the redesigned gear box. The gear box proved satisfactory, but the growth on the bottom of the ship has so reduced her speed that it will be unwise to undertake research until the fouling has been removed. During the short period when she was operating, 100 species of fish were identified and preliminary information was gained regarding their biology. Modifications in the classification of the Sciaenidae (Croakers) are being undertaken in consequence of this preliminary work.

27. The two smaller 30 ft. boats, namely the " Cape St. Paul " and the " Cape St. Anne " have given satisfactory service throughout. A trapping and trawling programme is being carried out in the estuaries, and in particular a line of trawling stations is being run three times a week up the Freetown Estuary. Catches average 60 lb. of fish per hour's trawling. Detailed observations are made on the fish caught with a view to studying their breeding and feeding and migratory habits.

28. A study has been started of the ecology and bio-chemistry of mangrove swamp, and samples of estuarine and deep-sea muds are also being examined.

Methods of assessing soil-fertility are being applied to these mangrove estuarine and deep-sea muds: the mangrove swamp work looks to the possibility of reclaiming

such swamps for fish ponds (and ricefields), and the deep-sea muds may prove a useful guide to fishing possibilities.

29. The study of the effect of dynamite on marine wood borers is nearing completion. It has been confirmed that the explosion of small charges of dynamite in the water near infested timbers will kill wood borers in their burrows.

30. As to fresh water, preliminary investigations on the productivity of local ponds with acid water have been undertaken, and the effects of the addition of lime to neutralize this acidity are being studied. A stock of suitable Tilapias for pond work is being maintained in two static water tanks on the premises.

The Research Station for Fish Culture at Penang, Malaya

31. No progress can yet be reported for this Station. The Director, Dr. C. B. Taylor, arrived at Penang at the end of March. Owing to the very steep rise in costs in Malaya, the whole scheme is under review, and may undergo substantial modification to reduce capital outlay.

The Marine Station at Singapore

32. No progress can be recorded yet at this Station. Dr. Ommanney has been appointed Director (see paragraph 13).

33. The Malayan Fisheries Department is undertaking research in advance of the establishment of the Marine Station at Singapore. Work in the plankton in Singapore Straits continues and is being correlated with physical conditions and statistics of the catches of fixed stake traps.

34. A correlation has been worked out between the significant physical and biological factors and from this correlation a prediction system has been worked out of the average catches of the fixed stakes in Singapore Straits.

The Marine Research Station at Hong Kong

35. This Station is being established and tenders are being placed for the Station's research vessel. The Station will be administered by Hong Kong University and will be largely staffed by graduates of that University.

IV. PUBLICATIONS

36. A series of Colonial Office Fisheries Research Publications has been started, and the following volumes have been published or are in the press.

Volume I, No. 1. "The Food and Feeding Relationships of the Fishes of Singapore Straits," by Tham Ah Kow, B.Sc., 1950.

Volume I, No. 2. "Report on the Tilapia and other Fish and Fisheries of Lake Nyasa," by Rosemary H. Lowe, B.Sc., 1952.

*Volume I, No. 3. "Report on the Mauritius-Seychelles Fisheries Survey 1948/49." In press.

V. LONG VACATION STUDENTSHIPS

37. During the Long Vacation, 1951 three students from Oxford and Newcastle worked at the West African Fisheries Research Institute with a small grant from Colonial Development and Welfare central funds. They gained useful experience and publication of their results is under consideration.

* A popular account of this expedition entitled "The Shoals of Capricorn" by Dr. F. D. Ommanney has recently been published.

VI. OTHER TERRITORIAL WORK

38. In addition to the work of the research stations, fishery development work in all territories includes much of research value.

39. In *Barbados* it is considered certain that there is a relation between the distribution of certain kinds of plankton and the distribution of the flying-fish, a plankton feeder which gives rise to a very important fishery.

40. In *British Guiana*, observations are being made on the growth and multiplication of the ricefields fish *Trichogaster pectoralis*; and in a series of freshwater ponds observations are being made on plankton production, and on the growth and spawning of fishes.

41. On the *Gold Coast*, the stocking of dams with fish has afforded evidence of their rate of growth and breeding. Tilapia species flourished best, followed by Clarias; the former bred repeatedly in the course of the year, and reached a weight of ½ lb. to ¾ lb. It is concluded that such dams, when stocked, could become valuable sources of fish; and the inhabitants of neighbouring villages soon learn to fish them with hook and line.

42. In the case of the Lawra dams, which are seasonally connected with the River Volta, valuable observations were made on upstream and downstream migrations of fish.

43. In *Northern Rhodesia*, work is being continued on the biology of fishponds, the newly appointed Fish Culturalist resuming the work of the former Fish Culturalist who retired through ill health. The effects of adding composts and fertilizers is being studied.

44. In *Tanganyika*, a demonstration fish farm is in full operation. Tilapia species grow to a length of 22 cm. (average 18 cm.) and a weight of 4–6 ounces, in four months from fry, and the yield of fish is of the order of half a ton per acre per annum without feeding or fertilization. The growth of fish in ricefields is also being investigated.

45. A study of the fishes of the Malagarasi Swamp and of Lake Rukwa, newly-filled after a period of drought, has been made in connection with fishery development there.

46. At the research station on the Upper Sagana River, in *Kenya*, important research work continues on the trout, its food, rate of growth and breeding. By means of traps and electric fishing the movements of fish upstream and downstream are being studied.

47. Now a second research station is being established on the Lower Sagana River to study the growth of coarse fish, principally Tilapias, in ponds under controlled conditions.

48. Though of indirect fisheries interest, a valuable report, with recommendations, has been made by the *Lake Victoria Fisheries Board*, in collaboration with the East African Forestry Research experts, on the dry-rot which causes serious deterioration in the timbers of wooden vessels on Lake Victoria.

49. The Fishery Officer in *Aden* has examined large numbers of sardinellas to find whether the disastrous decline in the formerly very important fishery of these sardinellas is due to an epidemic disease. He has found no obvious sign of parasites or disease as yet.

50. The important marine research being undertaken by the *Malayan* Government has been mentioned ealier in this report.

Report of the Director, Anti-Locust Research Centre, on Locust Research and Control, 1951-1952

Anti-Locust Research Centre,
British Museum (Natural History),
London, S.W.7
6th May, 1952.

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 1951–52.

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

1951—52

CONTENTS

LOCUST RESEARCH AND CONTROL

1951-1952

INTRODUCTORY

1. The general organisation of locust research and control during the period 1929–1950 has been summarised in a special report* and the first annual report for 1950 1951 was included in the Colonial Research report for that year.

ANTI-LOCUST RESEARCH CENTRE

2. The establishment of the Centre has been increased and the approved personnel now consists of the Director, a Senior Principal Scientific Officer, two Principal Scientific Officers, one Senior Scientific Officer, a Scientific Officer, two Experimental Officers, six Assistant Experimental Officers, two Scientific Assistants, a Secretary, Assistant Secretary, two typists and a clerk. Two research workers holding grants are carrying out their investigations at the Centre.

Information service

3. During the year 1,140 (600 last year) reports on locust situation have been received from 41 (30 last year) countries and territories. Current reports on the present Desert Locust plague (para. 26) are dealt with immediately and *Desert Locust Situation Summaries* accompanied by forecasts are circulated monthly to all affected countries.

Advisory activities

4. In addition to the normal advisory work, the Director has been invited to act as a consultant to the Standing Technical Advisory Committee on Desert Locust Control established by the Food and Agriculture Organisation of the United Nations (see para. 26). The appointment is significant as evidence of the value attached to advice from the Centre, and participation in the work of the Committee may eventually lead to a wider recognition of the international importance of the Centre.

Conferences, tours and lectures

5. The Director attended meetings of the Provisional International Council for the Control of the African Migratory Locust at Lagos, of the International Red Locust Control Council at Abercorn and of the Desert Locust Survey Advisory Committee at Nairobi, in June and July; and technical international conferences on the control of the Desert Locust in Cairo in March and in Rome in October, 1951, and in March, 1952. Dr. Gunn took part in tests of the Airflow sprayer in the Rukwa Valley, Tanganyika, in September (see para. 18). The Director and Miss Waloff attended meetings of the International Congress of Entomology in Amsterdam in September, 1951. Miss Waloff was in East Africa from November, 1950, till July, 1951, continuing investigations on locust flight activities (see para. 17). Lectures on locust research and control were given by the Director to the Colonial Group of the Royal Empire Society, and by Dr. Gunn to the Royal Society of Arts, the Society for Chemical Industry, at various Universities and through the B.B.C.

Locust laboratory

6. In the laboratory, over 300,000 locusts have hatched during the year; most of these were used for research in the Centre, but large numbers were sent out for extra-mural research, including about 7,000 adults.

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* Locust Research and Control. 1929-1950. *Colonial Research Publication No.* 10. H.M.S.O. 5s. net.

7. Mr. P. Hunter-Jones continued the work on morphological phase changes in locusts and showed that under laboratory conditions of selection, genetic factors can produce as big changes in the usual measures of phase status as environmental factors can. He is extending the investigations to characters of young locusts that are affected by the conditions in which the parents are reared. Arrangements have been made for genetical work to be carried on in a specialist laboratory.

8. Dr. Maud Richards has found that crowding has very little effect on the number of eggs laid by the Desert Locust but has a considerable accelerating effect on the rate of sexual maturation. Locusts kept in isolated pairs often show long delayed sexual maturation. Such delay may be ended if a mature male is introduced, for there is some mechanism by which males are stimulated to mature by the presence of males that are already mature.

9. Miss Davey has completed a survey of a number of materials that might be used as bait for the Desert Locust. All of the most acceptable dry materials were grain products, fresh grass came next, and none of the less acceptable materials was a grain product, except the husks of various grains, which came low in the order. The locusts pick out particles of bran from a mixture with less acceptable material, and this suggests that making a bait of bran and sawdust is wasteful, especially of insecticide.

Extra-mural research

10. Dr. Peggy Ellis, at University College, London, went on from investigations of the marching of locust hoppers, a still fruitful subject, to an attempt to elucidate the nature of and evidences for gregariousness in hoppers. Mr. Chapman has begun to examine the remaining behaviour of hoppers.

11. Dr. T. W. Goodwin in Liverpool University has completed his series of investigations with a review of pigmentary colouration in locusts. Mr. T. Weis Fogh in Copenhagen has, during the year, been rounding off some of his extensive work on several aspects of locust flight and is preparing a series of publications. Dr. B. Whittington in Sheffield and Miss P. Cook in Glasgow have terminated their researches on visual acuity in locust hoppers and on the physiological action of certain insecticides on the nervous system of the locust, respectively, and are preparing the results for publication.

12. The emphasis in the research field is being shifted to population dynamics. Two studentships in ecology are held by Mr. J. C. Basu Choudhuri and Mr. J. P. Dempster at the Imperial College of Science, and two more such studentships are now available.

Taxonomic research

13. The Taxonomic Section has been established on a permanent basis. Dr. Dirsh continued work on certain Acridid groups, and revisions of the group *Truxales* and the genera *Tropidauchen* and *Acrida* have been completed; and work commenced on *Catantops*, a very large genus including a number of economically important tropical grasshoppers. The study of internal genitalia of representatives of various genera has commenced, as a basis for a critical revision and key to African Acrididae. Mr. H. B. Johnston, working on a grant from the Centre, is proceeding with the preparation of an annotated catalogue of African grasshoppers. The collection of the Centre increased by 2,328 specimens.

Biogeographical research

14. Memoir No. 4, on the Desert Locust in North-East Africa and the Middle East, by Mr. D. E. Davies, has been published, and Memoir No. 5, by Miss

Fortescue-Foulkes on the Desert Locust in the Indo-Pakistani-Persian area is being edited for press. This completes the series of Memoirs dealing with generalised seasonal breeding and migration of swarms throughout the Desert Locust invasion area.

15. In addition to the routine work of plotting the current data on the Desert Locust outbreak and the preparation of the monthly summaries and forecasts, the Geographical Section have now commenced the analysis of breeding and migration data season by season and generation by generation. This analysis, which will take a considerable time to complete, should clarify the connection between different parts of the Desert Locust invasion area, and provide a basis for the investigation of climatic effects on the course of the plague, as well as for improvements in forecasting.

Statistics

16. A post of Statistician has been provided for in the revised establishment and Mr. D. E. Davies appointed to it. Statistical work carried out by Mr. Davies has included calculation of the calibrations for temperature measuring instruments for Miss Waloff's field research project; the estimation of discriminant functions using measurements of elytron, femur and caput of *Schistocerca gregaria* provided by Dr. Dirsh. An extensive analysis of measurements of elytron, femur, caput and weight provided by the Locust Laboratory for the E/F selection experiment was completed and an appendix prepared for publication.

Field research on adult locust behaviour

17. The reappearance of Desert Locust swarms in East Africa at the end of 1950 made it possible to resume investigations on the conditions affecting the incidence of flight and the speed and direction of swarm displacements. These investigations were carried out during January–March, 1951, in Kenya and Tanganyika by a joint Research Unit of the Desert Locust Survey and the Centre, consisting of Miss Z. Waloff and two research assistants. More data were obtained on the effect of environmental conditions on the incidence of flight and on the direction and rate of displacement of migrating swarms. The type of flight performed by locusts was found to be of some importance in determining the rate of displacement and indications were obtained suggesting that sustained flight requires high humidities. Field operations were suspended when swarms in the area became scarce after March, and the results are being analysed.

Research on control

18. Active co-operation with other governmental bodies and with industry on the development of control methods has continued. The " Airflow " spraying machine has been tested in the field by Mr. R. J. Courshee, of the National Institute of Agricultural Engineering, and found to be much more effective than any production model, though also considerably heavier. The use of special vehicles with large wheels was found to be advantageous in wet conditions, but the worst conditions require tracked-vehicles of low ground-pressure. Good progress has been made by Mr. N. W. Wootten, at the Ministry of Supply's establishment at Porton, in finding the amounts of spray picked up by locusts in flight, in connection with the possibility of spraying flying swarms from aircraft. A new development is the investigation of detoxication mechanisms in locusts under Professor R. Tecwyn Williams. Some fundamental investigations on insecticide dusts have been taken under the wing of the Agricultural Research Council.

REGIONAL ORGANISATIONS

International Red Locust Control Service

19. After many years' work on locusts in Central Africa, including seven years as Director of the International Red Locust Control Service at Abercorn, Northern Rhodesia, M. Hans Bredo is transferring to the Scientific Council for Africa South of the Sahara. His place is being taken by Dr. D. L. Gunn, on secondment from the Anti-Locust Research Centre. Incipient outbreaks of Red Locust occurred but were brought under control. Research work on the ecology of Red Locust outbreak areas continued to be carried out by Mr. D. Vesey-Fitzgerald and Dr. H. Backlund. Collection of the flora of outbreak areas has been completed by Mr. A. A. Bullock and the plants are now being studied by experts in Kew Herbarium. Mr. F. Albrecht has carried out valuable breeding experiments; the results suggest that the length of the rainy season may be important for a rapid increase in locust population owing to acceleration of sexual maturation of adult Red Locusts and repeated egg-laying.

Provisional International Council for the Control of the African Migratory Locust

20. It is hoped that an international convention to establish this organisation on a permanent basis will be signed shortly. In the meantime, the organisation continues to keep the outbreak area of the African Migratory Locust on the Middle Niger under satisfactory control. The research activities of the organisation, however, are still intermittent, as there is no permanent Scientific Officer. The results of ecological research by M. Remaudière carried out in 1950 are being prepared for publication. Since November, 1951, Mr. J. T. Davey, Government Entomologist, on secondment from Nigeria, has been carrying out a survey of the distribution of adult locusts on the fringes of the Niger outbreak area, since recent evidence suggests a possibility of migration of solitary locusts outside the area, thus complicating the dynamics of outbreaks.

Desert Locust Survey

21. A disturbance of the normal activities of the Desert Locust Survey by diversion of some of its personnel to control duties has been eliminated to some extent by the development of the Desert Locust Control Organisation (see para. 25).

22. Research activities of the Survey consisted in the exploration of less known Desert Locust areas in Arabia; studies on locust biometrics, hopper behaviour and ecology, including microclimatic investigations; and field experiments with insecticides and machinery. An important advance in the study of locust migrations on the basis of synoptic meteorology has been made by the theory, advanced by Dr. R. C. Rainey, on the importance of the movements of the Intertropical Convergence Zone in relation to swarm displacements.

23. Trials of light aircraft (Auster Aiglet) for aerial spraying of flying locust swarms were carried out in Kenya by Dr. Rainey and Mr. H. J. Sayer, in January–March, 1952. Although handicapped by the small number of suitable swarms, the trials showed that light spraying aircraft may become an effective and economical weapon against flying swarms.

Moroccan Locust Research Team, Cyprus

24. Intensive work on the ecology and population dynamics of the Moroccan Locust in Cyprus has been carried out by a research team consisting of Mr. F. Merton (plant ecologist) and Mr. S. J. Curry (entomologist) since January, 1951, and the abundant data were partly analysed in England during summer when field

work on this locust is at a standstill. Field operations were resumed in the autumn, and dynamics of vegetation and of locust population followed throughout the season. Parallel with field work, laboratory observations have commenced on the conditions affecting hatching, rate of development and egg-laying.

DESERT LOCUST CONTROL

25. The Desert Locust Control Organisation based on Nairobi has been strengthened during the year, and extensive operations were conducted in several countries. By October, 1951, the main infestation was confined to British Somaliland and adjoining parts of Italian Somalia, Ethiopia and Kenya. Exceptional rains and, in some areas, the opposition of nomadic tribes to the use of poison bait (although it is harmless to stock) handicapped the work and considerable escapes of swarms occurred. These swarms were expected to move south and invade East Africa, but, instead, a northerly migration developed and by March swarms, crossing the Red Sea and Gulf of Aden, invaded most of the Arabian peninsula, reached Iraq and Jordan, and spread across Iran to the Pakistan border. In three months, the swarms travelled nearly 2,000 miles and the infested area increased enormously. Preparations to meet the danger have been made well in time, with 2,600 tons of poison bait distributed over Arabia; some 40 technical officers, with 170 vehicles and spraying and dusting machines were engaged in the operations which commenced in March.

26. An encouraging feature of the present control campaign is the growing international co-operation. During recent years the Governments of the United Kingdom and East Africa have been carrying a heavy financial burden (over £1 million per annum) in controlling, for the protection of East Africa, locusts mainly outside British territories. Now, however, the governments of some of the countries bordering on Arabia are assisting in the work there. Useful assistance, in the shape of light aircraft and insecticides, has been given also by the United States, and the Food and Agriculture Organisation of the United Nations is taking an active interest in co-ordinating the efforts of all countries against the common danger. A Standing Technical Advisory Committee on Desert Locust Control, established by FAO, aims at pooling the resources of all threatened countries and using them on the basis of common strategic plans, developed and modified according to the advice which the Anti-Locust Research Centre is relied upon to produce from the information regularly supplied by the countries.

APPENDIX I

ADVISORY COMMITTEE ON ANTI-LOCUST RESEARCH

Membership

SIR GEOFFREY EVANS, C.I.E., M.A., Royal Botanic Gardens, Kew. (*Chairman.*)

MR. K. G. ASHTON, Colonial Office.

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. D. L. GUNN, Principal Scientific Officer, Anti-Locust Research Centre.

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.

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

BURNETT, G. F., 1951. Field observations on the behaviour of the Red Locust (*Nomadacris septemfasciata* Serville) in the solitary phase.—*Anti-Locust Bull.*, London, No. 8: 66 pp., 2 maps, 6 figs.

JOYCE, R. J. V., 1952. The ecology of grasshoppers in East Central Sudan.—*Anti-Locust Bull.*, London, No. 11: 97 pp., 2 maps, 10 photos, 22 figs.

UVAROV, B. P., CHAPMAN, E., WALOFF, N., & WATERSTON, A. R., 1951. Observations on the Moroccan Locust (*Dociostaurus maroccanus* Thunberg) in Cyprus, 1950.—*Anti-Locust Bull.*, London, No. 10: 54 pp., 10 photos, 2 figs.

WALOFF, Z. & RAINEY, R. C., 1951. Field studies on factors affecting the displacements of Desert Locust swarms in eastern Africa. RAINEY, R. C. & WALOFF, Z., 1951. Flying locusts and convection currents.—*Anti-Locust Bull.*, London, No. 9: 72 pp., 1 map, 8 figs.

ANTI-LOCUST MEMOIR.

DAVIES, D. E., 1952. Seasonal breeding and migrations of the Desert Locust (*Schistocerca gregaria* Forskål) in north-eastern Africa and the Middle East.—*Anti-Locust Mem.*, London, No. 4: 57 pp., 13 maps, 2 figs.

JOURNAL PAPERS, written by members of the staff, sponsored or otherwise assisted by the Centre.

BURNETT, G. F., 1951. Observations on the life-history of the Red Locust, *Nomadacris septemfasciata* (Serv.) in the solitary phase.—*Bull. ent. Res.*, London, *42:* 473-490, 5 figs.

BURTT, E., 1951. The ability of adult grasshoppers to change colour on burnt ground.—*Proc. R. ent. Soc. Lond.* (A) *26:* 45-48, 1 pl.

BURTT, E., 1951. Occurrence of fully-winged forms in usually brachypterous African Pyrgomorphinae.—*Proc. R. ent. Soc. Lond.* (A) *26:* 64-66, 1 pl.

COOK, P. M., 1951. Observations on giant fibres of the nervous system of *Locusta migratoria.—Quart. J. micr. Sci.*, London, *92:* 297-305 ,1 pl., 4 figs.

DIRSH, V. M., 1951. A new grasshopper (Orth. Acrididae) damaging groundnuts. *Bull. ent. Res.*, London, *42:* 41-43, 9 figs.

DIRSH, V. M., 1951. Revision of the group Truxales (Orthoptera, Acrididae).—*Eos, Madr.*, Tomo extraord. (1950): 119-248, 10 maps, 224 figs.

GOODWIN, T. W., 1951. Biochemistry of locusts. 7. A note on the effect of breeding temperature on the carotenoid content of locusts (the African Migratory Locust, *Locusta migratoria migratorioides* R. & F. and the Desert Locust, *Schistocerca gregaria* Forsk.)—*Biochem. J.*, London. 49: 86-87.

GOODWIN, T. W. & SRISUKH, S., 1951. Biochemistry of locusts. 5. The green pigment of the haemolymph and integument of solitary locusts (*Locusta migratoria migratorioides* R. & F., and *Schistocerca gregaria* Forsk.)—*Biochem. J.*, London, 48: 199-203, 3 figs.

GUNN, D. L., 1951. Appâts secs au son de blé.—*Bull. Off.* nat anti-acrid., Paris, No. 1: 19-24.

GUNN, D. L., 1952. Field tests of dry baiting against the Desert Locust, *Schistocerca gregaria* (Forsk.).—*Bull. ent. Res.*, London, *42:* 675-690, 6 figs.

GUNN, D. L., 1952. The Red Locust.—*J. R. Soc. Arts*, London, *100:* 261-284, 4 maps, 5 photos, 6 figs.

GUNN, D. L. & YEO, D., 1951. The Bellani spherical pyranometer or radiation integrator; the calibration of an improved model, and some suggestions for further improvements.—*Quart. J. R. met. Soc.*, London, *77:* 293-301, 2 figs.

KENNEDY, J. S., 1951. The migration of the Desert Locust (*Schistocerca gregaria* Forsk.). i. The behaviour of swarms. ii. A theory of long-range migrations.—*Philos. Trans.*, London, (B) *235:* 163-290, 14 figs.

KROGH, A. & WEIS-FOGH, T., 1951. The respiratory exchange of the Desert Locust (*Schistocerca gregaria*) before, during and after flight.—*J. exp. Biol.*, Cambridge, *28:* 344-357, 4 figs.

POPOV, G., 1951. Some new Iranian Acrididae.—*Proc. R. ent. Soc. Lond.* (B) *20:* 110-120, 1 pl., 12 figs.

RAINEY, R. C., 1951. Weather and the movements of locust swarms: a new hypothesis.—*Nature, Lond., 168:* 1057-1060, 2 maps.

SLIFER, E. H., 1951. Some unusual structures in *Locusta migratoria migratorioides* and their probable function as thermoreceptors.—*Proc. roy. Soc.*, London (B) *138:* 414-437, 21 figs.

THOMAS, J. G., 1952. A comparison of the pterothoracic skeleton and flight muscles of male and female *Lamarckiana* species (Orthoptera, Acrididae).—*Proc. R. ent. Soc.* Lond., (A) 27: 1-12, 6 figs.

UVAROV, B. P., 1951. Some synonymy in the genus *Locusta* Linné.—*Bull. Off. nat. anti-acrid.*, Paris, No. 1: 1-4.

UVAROV, B. P., 1951. Some recent advances in locust research.—*Advanc. Sci.*, London, *8:* 17-22.

UVAROV, B.P., 1951. The genus Caloptenopsis. 1. Bolivar and its allies (Orthoptera, Acrididae).—*Eos, Madr.*, Tomo extraord. (1950): 385-413.

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