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COLONIAL OFFICE

COLONIAL RESEARCH

1949—50

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, Fungicides and Herbicides Committee

Colonial Economic Research Committee

Presented by the Secretary of State for the Colonies to Parliament by Command of His Majesty

October 1950

LONDON

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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 (1949-1950)

The Church House,
Great Smith Street,
Westminster, S.W.1
30th June, 1950.

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 1949–50.

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

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

COLONIAL RESEARCH COUNCIL

Membership

THE MINISTER OF STATE FOR THE COLONIES (*Chairman*).

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

PROFESSOR P. A. BUXTON, C.M.G., F.R.S. (Chairman, Colonial Insecticides, Fungicides and Herbicides Committee).

SIR ALEXANDER CARR-SAUNDERS, M.A., LL.D. (Chairman, Colonial Social Science Research Council).

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DR. H. P. HIMSWORTH, M.D., F.R.C.P. (Chairman, Colonial Medical Research Committee).

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

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).

PROFESSOR R. H. TAWNEY (Professor of Economic History, University of London).

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 1949–50

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COLONIAL RESEARCH COUNCIL

ANNUAL REPORT ON COLONIAL RESEARCH

(1949-1950)

INTRODUCTORY

1. As in previous years, the report of the Council deals with research matters of general interest and with specific research not covered by the specialist advisory research committees concerned with Agriculture, Animal Health and Forestry, Colonial Products, Economic Research, Insecticides, Fungicides and Herbicides, Medical Research and Social Science Research, whose separate reports are annexed.

2. The Minister of State for the Colonies (The Rt. Hon. John Dugdale, M.P.) succeeded Mr. D. R. Rees-Williams as Chairman of the Council in March, 1950. During the year under review Sir Ben Lockspeiser, M.A., D.Sc., M.I.Mech.E., F.R.AE.S., F.R.S., succeeded Mr. Eric Barnard as the representative of the Department of Scientific and Industrial Research on the Council. Dr. H. P. Himsworth, M.D., F.R.C.P., became a member on succeeding Sir Edward Mellanby as Chairman of the Colonial Medical Research Committee, Dr. Norman Wright, M.A., F.R.I.C., became a member on appointment as Chairman of the Committee for Colonial Agricultural, Animal Health and Forestry Research and Professor P. A. Buxton, C.M.G., F.R.S., became a member on succeeding Sir Ian Heilbron as Chairman of the Colonial Insecticides, Fungicides and Herbicides Committee.

I. GENERAL

Research schemes made in 1949/50 *and their cost*

3. These matters have been under review by the Council during the year. A list of the schemes made during the year and the grant allotted in each case from Colonial Development and Welfare funds is given in Table I of the Appendix. The schemes comprise 76 new schemes and 67 supplementary schemes, and the total sum allotted to them amounted to £1,795,999. This compares with £1,652,169 for 1948/49 and a little over £2 million for 1947/48 and brings the total sum allocated for research schemes from Colonial Development and Welfare funds since 1940 to nearly £7¾ million. From this last figure must be deducted about £½ million arising from the revision of schemes, unspent balances on completed schemes, etc., so that the net expenditure and commitment is of the order of £7¼ million. As indicated in Table I, many of these schemes are assisted by substantial contributions made by the Colonial Governments concerned from their own resources. It is estimated that this additional assistance provided in cash or in kind from Colonial Governments and industry since 1940 can be represented by a figure not far short of £1¾ million. About 32.5% of the total allocation has been for agricultural, veterinary and forestry schemes, 14.4% for medical research, 14.0% for fisheries research, 8.7% for social science and economic research, 7.6% for tsetse and trypanosomiasis research, 6.5% for insecticides research, 4.6% for colonial products research, 4.1% for anti-locust research and 7.6% for other miscellaneous purposes. About 37½% of the total allocation has been for schemes to benefit the East African territories, 19% for the West African group, 13% for the West Indian Colonies, British Guiana and British Honduras, 10% for Hong Kong and the South-East Asian territories, 5% for Northern Rhodesia and Nyasaland and 15½% for other territories and for schemes of concern to all territories. Table II shows the allocations made for research each year from 1940 to 1949/50. Table III shows the actual disbursements

made during each of the financial years since the year 1940/41. It will be noted that the figure for the year under review is well over £1¼ million. The disbursement of this sum has been rendered possible by the Colonial Development and Welfare Act, 1949, which raised the annual limit for disbursements on Colonial Development and Welfare Research schemes from £1 million to £2½ million. The notable increase in the amount paid out during the year under review is a further indication of the gradual overcoming of the factors which have hitherto hampered progress, such as shortages of scientific personnel, labour, building materials and equipment, to which reference was made in last year's report.*

4. Some of the more important schemes made during the year concerned medical and fisheries research. The former included provision for expanding and maintaining for five years the former Rockefeller Yellow Fever Institutes at Lagos, in Nigeria, and at Entebbe, in Uganda, which were taken over as a British responsibility on the 1st January, 1950. These institutes will in future deal with all virus diseases affecting West and East Africa respectively. Other medical schemes of importance included the investigation of the incidence of loiasis in the British Cameroons by a small team of workers, the establishment of a filariasis research unit in East Africa, the establishment of an East African malarial unit and further assistance towards scrub typhus research in Malaya.

5. The fisheries research schemes included provision for the maintenance for five years of the Institute for Research and Training in Fish Farming at Penang, in Malaya, the high importance of which was explained in paragraph 45 of last year's report, and the establishment of an East African Marine Fisheries Research Station in Zanzibar and of a Fisheries Research Station at Fort Rosebery in Northern Rhodesia to serve that territory and Nyasaland.

6. Other schemes of importance recorded in Table I include provision for the continuance and expansion of the work of the East African Insecticides Research Unit and its establishment at new headquarters at Arusha in Tanganyika ; for experiments on the dissemination of insecticides from fixed-wing aircraft ; for the continuance of the work of the Anti-Locust Research Centre for a further five years ; for research to ascertain the causes of the swarming of the Moroccan locust in Cyprus and the best methods of prevention ; for the establishment of a tsetse fly research unit in Northern Rhodesia ; for assistance towards the maintenance and expansion of the Ebini Livestock Experimental Station in British Guiana ; for the construction and equipment of an hydraulic laboratory for the Department of Drainage and Irrigation, Federation of Malaya, which will be of material assistance to the rice industry ; for the continuance for a further five years of the sociological work of the Rhodes-Livingstone Institute in Northern Rhodesia ; for the appointment of a Director of the projected West African Institute for Social and Economic Research at Ibadan, in Nigeria, and for the maintenance of the West Indian Institute for Social and Economic Research in Jamaica ; for the establishment and maintenance of an Institute of Educational Research in Fiji ; for the appointment of a Director of the East African Scientific and Industrial Research Organization which will take over and expand the work of the East African Industrial Board ; and for the appointment of Colonial Liaison Officers at the Road Research and Pest Infestation Laboratories of the Department of Scientific and Industrial Research.

Colonial Research Service

7. The introduction of this Service, with effect from the 1st January, 1949, was publicly announced on the 31st January, 1950. The terms and conditions

* Cmd. 7739.

of service are set out in a Colonial Office pamphlet* which was published on that day. The terms and conditions were prepared in the Colonial Office after prolonged consultation with the Council, the specialist advisory research committees, all the Colonial Governments, H.M. Treasury and other interested parties. The object has been to create a Service with salary, terms of service and standards comparable to those for research workers in the United Kingdom, and thereby to make interchange of workers between the United Kingdom and the Colonies much easier and render it possible for the research worker to earn a continuous pension whether he spends all his career in the Colonial Empire or only part of it.

8. The Service is intended to cover research workers who will undertake scientific research for the benefit of the peoples of the Colonial Empire, and officers appointed to it will be required to accept liability for duty in any part of the Colonial Empire, or from time to time duty in the United Kingdom or elsewhere, as determined by the Secretary of State.

9. For workers other than medical research workers, the basic salary scales are exactly the same as those obtaining for the United Kingdom Scientific Civil Service; in the case of medical research officers possessing the requisite qualifications, the basic scales are those adopted by the Medical Research Council. An overseas research allowance, which varies according to the Colonial region in which the officer will serve, is paid in addition to the basic salary in order to compensate the officer for living abroad and to bring his total emoluments up to Colonial Service levels.

10. For officers engaged on research other than medical or veterinary research, the minimum qualification will normally be a good honours degree of a recognized British Commonwealth University and two years post-graduate training or approved experience in scientific research; for officers engaged on medical or veterinary research, a medical or veterinary qualification registrable in the United Kingdom. Candidates for permanent appointment to the Service must normally be British subjects or British protected persons.

11. Superannuation benefits for the officer and his dependants on a contributory basis will be provided under a Colonial Superannuation Scheme which it is hoped will be introduced in the course of the next twelve months. Pending the initiation of this scheme, an officer who already belongs to an approved superannuation scheme, such as the Federation Superannuation System for Universities (F.S.S.U.), will be able, if he so desires, to continue to belong to that scheme, in which event he would pay reduced contributions to the Colonial Superannuation Scheme which would entitle him to proportionate benefits. Other officers will be eligible for a gratuity at the rate of 15% of total basic salary in respect of the period of their membership of the Colonial Research Service up to the date when the Superannuation Scheme is introduced.

Recruitment of Scientists

12. The recruitment of scientists, especially young scientists, definitely improved during the year under review. Major appointments included the Directors of the East African Social Science Research Institute, the West African Social and Economic Research Institute, the West African Fisheries Research Institute, and the East African Virus Research Institute. The various Colonial Research Studentship Schemes, notably soil science and fisheries, attracted a considerable field of candidates and should result in many useful research workers being secured for duty in the Colonial Empire.

* "Appointments in His Majesty's Colonial Research Service," obtainable from the Research Department, Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1.

Colonial Research Fellowships

13. Two Fellowships, both in anthropology, were awarded during the year to two students from the Union of South Africa.

African Regional Scientific Conference

14. This Conference, which was held in Johannesburg during October/November, 1949, was attended by representatives from the United Kingdom, France, Belgium, Portugal and the various African countries south of the Sahara. The United Kingdom delegation was led by Sir Ben Lockspeiser and included Sir Edward Mellanby, Mr. C. G. Eastwood, Assistant Under-Secretary of State, Economic Division, Colonial Office, the Director of Colonial Medical Research, the Secretary for Colonial Agricultural Research, several of the other advisers to the Secretary of State and members of the specialist advisory research committees. Delegations were also sent from the British territories in East, Central and West Africa, and the Conference provided a most valuable opportunity for the interchange of views and the making of useful contacts.

15. The main resolution of the Conference recommended the establishment of a Scientific Council for Africa south of the Sahara The Council was envisaged as being essentially advisory and consultative, and its main functions as including the encouragement and establishing of contacts between research workers in the same or related scientific fields or in the same region; the study of what research problems of common interest could be usefully suggested to Governments, research agencies or universities; the promotion of inter-governmental collaboration; the compilation and distribution of reports and information of general value concerning scientific workers, scientific equipment and libraries which was not already undertaken by other agencies; the fostering of the creation in Africa of centres of specialised documentation in respect of each of the major scientific subjects; the proposing to Governments of the convening of Conferences and the facilitation of meetings of groups of specialists, and the submission to the metropolitan Governments of recommendations with a view to joint administrative action on them being secured through the recently established inter-governmental Committee for Technical Co-operation in Africa.

16. The main resolution has been accepted by His Majesty's Government in the United Kingdom and by the British Colonial Governments concerned.

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

17. The progress made in promoting this most useful connection in the fields of building, road and water pollution research is recorded in the second part of this report. During the year Colonial Governments have nominated correspondents with the D.S.I.R. Pest Infestation Laboratory, and it is hoped to appoint a Colonial Liaison Officer there in the near future.

18. The Department of Scientific and Industrial Research should also be able naturally to assist the Director of the East African Scientific and Industrial Research Organisation, which will take over and expand the work of the East African Industrial Board. A Colonial Development and Welfare Research scheme to defray part of the cost of appointing a Director for five years was made, with the concurrence of the East African Governments, after the scheme had been examined and commented upon by the Council. It is hoped that the appointment will be made at an early date.

Assistance under Marshall Aid given by the United States Economic Co-operation Administration

19. During the year several highly qualified American agricultural and medical scientists visited the British African Colonial territories, and on their return presented reports containing many interesting suggestions as to how American scientific personnel could usefully be employed on major Colonial problems. These proposals have been carefully examined by the Secretary of State's advisers and the appropriate advisory committees, in the light of the views expressed on them by the Colonial Governments, and a number of them have been endorsed and referred to the Economic Co-operation Administration for consideration.

Colonial Research Publications

20. The following reports were approved during the year for publication by His Majesty's Stationery Office in the "Colonial Research Publications" series. The first three have been published.

Report on Tobacco, with particular reference to the prospects of increased production in Central and East Africa, by S. S. Murray, M.B.E., Commissioner for Nyasaland in London. (Publication No. 4. 2s. net.)

Grain Storage in East and Central Africa. Report of a survey made between October, 1948, and January, 1949, by T. A. Oxley, Pest Infestation Laboratory, Department of Scientific and Industrial Research. (Publication No. 5. 3s. net.)

Studies in mental illness in the Gold Coast, by Geoffrey Tooth, M.D., M.R.C.S., M.R.C.P., D.P.M. (Publication No. 6. 2s. 6d. net.)

Contagious Caprine Pleuro-Pneumonia, by E. O. Longley, B.Sc., M.R.C.V.S. (Publication No. 7.)

Colonial Road Problems. Impressions from visits to Nigeria, by H. W. W. Pollitt, Road Research Laboratory, Department of Scientific and Industrial Research. (Publication No. 8. 3s. net.)

Rat problems in Cyprus. Report on investigations made in carob-growing areas, by J. S. Watson.

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)

21. During the year further research has been undertaken by the African Studies Branch of the Colonial Office into the contemporary history and problems of African administration. Studies have been made of recent constitutional reforms in Nigeria and the Gold Coast, and also of the development of local government in these two territories and in the Sudan. In addition, the Branch has made surveys of legislation and practical measures taken to control the growth of mushroom towns, racial discrimination in the African Trust Territories and the position of civil servants as members of local government bodies. The Survey of Systems of African Taxation has now been completed and is being published in the Journal of African Administration. The detailed study of the forms and conventions of African constitutions, undertaken by the Branch last year, progresses steadily and is nearing completion.

22. In June, 1949, Mr. R. S. Hudson, C.M.G., formerly Secretary for Native Affairs in Northern Rhodesia, was appointed Head of the Branch. In January,

1950, he left on a ten-week tour of Nigeria with the object of making a first-hand study of native administration there. Further visits of a similar nature to the remaining British territories in West, East and Central Africa are contemplated for the future.

23. Lord Hailey has now completed his survey of African Native Administration and the organisation of Native Courts, and arrangements for the publication of this work are in hand.

24. *Local Government.* The Colonial Local Government Advisory Panel met frequently during the past year and its advice has been of great value to Colonial Governments. Detailed recommendations were made, in consultation with representatives of the Nigerian Government, on draft ordinances providing for the introduction of a modern system of local government in the Eastern Provinces of Nigeria and for the establishment of a wholly-elected Municipal Council in Lagos carrying increased powers and responsibilities. Arising out of the proposals for the reform of local government in the Eastern Provinces of Nigeria and the introduction of local authorities enjoying greater powers and duties than have hitherto been enjoyed by the " Native Authorities," the Branch, at the request of the Nigerian Government, undertook to arrange a five-month course of local government training in the United Kingdom for a party of twenty-one Nigerian local government officers. The party arrived in this country in March, 1950.

25. *Land Tenure.* Although the Colonial Land Tenure Advisory Panel had no occasion to meet during the year, individual members have continued to give valuable advice on the numerous questions of land policy and land registration referred to them. Work on the bibliography of published sources relating to Land Tenure in the Far East, prepared at the direction of the Panel, is still proceeding and it is hoped that publication will take place towards the end of 1950. Sir Ernest Dowson and Mr. V. L. O. Sheppard have now completed the preparation of the second part of their paper on Land Registration, entitled " A Comparative Analysis of the Salient Features of Registration of Title to Land under Various Jurisdictions " and copies should be available very shortly.

26. *Native Law.* The African Marriage Survey under the direction of Mr. A. Phillips, a member of the Colonial Native Law Advisory Panel, has continued its research into this aspect of African customary law. The Branch has assisted by enlisting the help of Colonial Service Officers in the African territories in submitting data for examination. It is hoped that Mr. J. N. D. Anderson, O.B.E., lecturer in Islamic Law at the School of Oriental and African Studies, will shortly be able to visit East and West Africa to make a comprehensive survey of the administration of Islamic Law and Courts in British Colonial Africa.

B. Anti-Locust Research and Control

27. The work of the regional anti-locust organisations in Africa, administered and financed on an international basis, is developing steadily. The headquarters of the International Red Locust Control Organisation, established on a long-term basis, are now provided with excellent buildings, and with a full complement of scientific personnel. A botanical survey of outbreak areas has been initiated, assisted by Mr. A. A. Bullock, Royal Botanic Gardens, Kew. Field observations on locusts in relation to seasonal vegetation changes are also in progress.

28. An international convention for establishing a similar organisation for the control of outbreak areas of the African Migratory Locust has been prepared

and is likely to be signed soon. In the meantime, the existing organisation has achieved a signal success in suppressing an incipient outbreak of the locust, which in the spring of 1949 had begun swarming; about 1,000 small locust concentrations were exterminated and the danger of an invasion of tropical Africa prevented. The organisation has financial provision for research, and investigations on the ecology of the locust are in progress.

29. The Desert Locust Survey, a British organisation established to watch the outbreak areas of the Desert Locust, has its headquarters at Nairobi and field bases at Asmara, Hargeisa and Jedda. Regular surveys of solitary locust populations are being carried out and studies on the ecology and behaviour of locusts in relation to weather and vegetation have been organised in co-operation with the Anti-Locust Research Centre, who have lent the services of an officer for this purpose.

30. A new outbreak of the Desert Locust commenced in India and Pakistan during the summer of 1949, and a technical conference to consider the means for its control in the earliest possible stage was called by the Pakistan Government at Karachi. A practical scheme for co-ordination of national efforts has been worked out, and a British-Pakistani locust control team sent to Trucial Oman, in Eastern Arabia, which is considered to be a key area of the campaign. There is a danger of locust breeding in southern Iran, where control is organised by the local authorities. Investigations of certain outlying areas in Arabia, which are suspected to be favourable for outbreaks are in progress.

31. A scheme for research on the ecology of the Moroccan Locust in Cyprus has been approved, but no suitable candidates for permanent appointments have been found, and it is proposed to carry out preliminary investigations in the spring of 1950 with temporary personnel.

32. The Director of the Anti-Locust Research Centre, Dr. B. P. Uvarov, attended meetings of the various committees administering regional organisations in Nairobi, Abercorn, Paris and Karachi. He also visited India at the invitation of the Government to advise on local organisation; and the Anglo-Egyptian Sudan, where serious grasshopper infestation has developed in connection with the Mechanised Crop Production Scheme in the Gedaref district. Dr. D. L. Gunn attended an International Conference on the Moroccan Locust convened by the Food and Agriculture Organisation at Beirut, where outbreak prevention by ecological means was one of the subjects discussed.

33. The advisory activities of the Centre have increased, particularly in connection with the development of regional organisations, and they impose a heavy strain on the senior personnel, as the provision of advice on the spot necessitates long tours abroad, interfering with research activities at home. An important new service rendered by the Centre is the issue of periodical lists and abstracts of current literature on locust research and control, which are circulated to workers in the field.

34. The *Anti-Locust Bulletin*, published during the year, describes field observations on locusts in Eastern Africa by H. B. Johnston and D. R. Buxton; another *Bulletin*, by Mrs. M. J. Richards, on the fecundity of the African Migratory Locust, is in the press. Seven journal papers, written by members of the staff or sponsored by the Centre, have been published dealing with the biochemistry of locust pigments (2 papers), oviposition behaviour, migratory locust in England in 1947-48, an aerodynamic sense organ in locusts, application of insecticides from the air and principles of anti-locust policy.

35. Fundamental research is carried out in the Locust Laboratory of the Centre (phase variation) and in several University laboratories ; the problems under study include sense organs, flight and metabolism, the marching of hoppers, neurotoxic insecticides, insecticide dusts, drop pick-up by flying locusts, the biometrics of locust phases and the taxonomy of injurious grasshoppers.

C. Building and Housing Research

36. During September to December, 1949, the Colonial Building Liaison Officer (Mr. G. A. Atkinson) visited the Gold Coast, Nigeria, Nyasaland, Northern Rhodesia, Kenya, Tanganyika, Zanzibar and Uganda. As a member of the United Kingdom delegation, he attended the African Regional Scientific Conference, held in Johannesburg during October, 1949, and presented a paper on " Building Research and the Problems of Building in Tropical Africa". He also paid short visits to Southern Rhodesia and the Sudan. The object of this tour was to survey building and housing activities in the different territories, and to discuss on the spot with those directly concerned how best the Colonial liaison organisation at the Building Research Station of the Department of Scientific and Industrial Research could be of assistance. Special attention was paid to the facilities available for testing building materials, and for research and experimental work. A number of rural housing schemes were visited, but, because of shortage of time, the survey was confined mainly to building in the bigger towns.

37. It was apparent that many of the problems discussed were not confined to one territory. This was only to be expected as the major influences affecting building in Africa, such as the tropical climate, long distances between urban centres and the relatively backward state of industrial development, are common to a greater or lesser extent to all territories. It was also apparent that many of the problems are inter-dependent ; for example, improved and cheaper housing depends on the better manufacture and use of local materials which, in turn, depend on better facilities for experiment and research, and on the training and recruitment of artisans and technicians.

38. The existence of an organisation whose duty it is to keep architects, builders, civil engineers and others informed of what is happening in the field of housing and building in other territories and in the United Kingdom was welcomed. With one exception, the Liaison Officer met his official correspondents in all the territories visited. Their interest and assistance showed that this aspect of the organisation is a valuable one. The Circular Letters which are being sent to these correspondents have proved useful. It was however felt that much of the information contained in the Letters merited wider circulation. It is therefore proposed to start a series of Colonial Building Notes which will be more widely distributed. They will appear at fairly frequent intervals and will contain information, including digests of publications issued in the United Kingdom and the Colonies, likely to be of interest to Colonial builders.

39. Efforts are being made to develop local building materials in most territories, but often one of the main deterrents to their greater use is their poor, or at least their variable, quality. To improve this, facilities for testing materials locally are necessary. In most of the African territories some such facilities now exist, usually at the headquarters of the Public Works Department. Their primary purpose is to test civil engineering materials, and especially soils for road and airfield construction, but they are, or are being, equipped to carry out standard tests on building materials. The services of some of these materials laboratories, like that of the Kenya Public Works Department are being made

available to the general public at a standard rate of charges. This is a development which should do much to foster the growth of healthy local building material industries.

40. Many enquiries are being received at the Building Research Station about methods of using earth for walling. The use of earth as a material is traditional in many regions and it is particularly attractive for rural and suburban building. The main objections to its use are, however, poor resistance to the weather, low strength, and cracking, which provides a harbourage for vermin. Of recent years, the scientific study of soils as an engineering material has been greatly expanded. Though the main emphasis of this work has been towards the better use of low-grade materials for road and airfield construction, with discretion, the knowledge gained can be applied to building. Experimental work carried out in the Gold Coast by Mr. A. E. S. Alcock, and in other territories, has shown that suitable earths rammed in moulds or preferably, pressed in machines, can make satisfactory building blocks. This is especially so when small percentages of cement are added to increase resistance to moisture penetration, strength and durability. The successful use of blocks of this kind is reported from East and West Africa and the West Indies. There are a number of problems involved in the economic development of this material, some of a fundamental nature, which should be studied experimentally.

41. The Colonial Liaison Officer has been assisting Mr. W. D. MacGregor, of the Forest Products Research Laboratory, in the preparation of a manual on termites, timber and building, which will be published as a Forest Products Research Laboratory Bulletin. He has made a survey of the space and accommodation standards required or suggested for low-cost housing in different territories and has also reviewed labour housing and labour housing legislation.

D. Demography and Census

42. The second volume of the late Dr. Kuczynski's Colonial Demographic Survey was issued during the year.* This volume covers East Africa, the South African High Commission Territories, Mauritius and Seychelles.

43. The round of census-taking in the Colonies which started during the final war years and which attained a peak shortly after the war is almost complete. The stage has now been reached when experience and progress must be reviewed and the scope of censuses in Colonial territories examined in the light of the recommendations made by the Populations Commission of the United Nations. Consideration will also have to be given to the frequency of future censuses and to the desirability of their being brought into line with the world as a whole by moving towards census taking around the "0" years. The first step towards policy decisions on these matters was taken when they were discussed at a Conference of Government Statisticians held in the Colonial Office at the end of March, 1950.

E. Engineering Research

44. The Crown Agents' Engineering Advisory Service continued to furnish technical information to visiting Colonial officials and by written reply to enquiries from the Colonies. The Advisory Service maintained contact as necessary with the Building Research Station, the Road Research Laboratory and the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research.

* "A Demographic Survey of the British Colonial Empire," Volume II, by R. R. Kuczynski (Oxford University Press—75s. net).

45. The fourth and fifth numbers of the Crown Agents Review were published during the year. The information on general technical matters which the Review provides has proved of use and interest to Engineering Officers and others in the Colonial Service and requests for copies are increasing. Literary contributions from Colonial sources have been forthcoming, but there is scope for expansion.

F. Fisheries Research

46. The three main Colonial Development and Welfare Fisheries Research schemes made during the year are recorded in paragraph 5. Preliminary work on the site for the Fish Farming Research and Training Institute at Penang has begun, and the post of Director has been advertised. A new Director has been appointed to take charge of the West African Fisheries Research Institute, and has gone to West Africa, after making contacts with modern laboratories and staffs in the United Kingdom, and with suppliers of scientific equipment.

47. The Fisheries Research Institute at Jinja, on Lake Victoria, started work during the year, and now has a European staff of four scientists and two technical officers. Routine work on the stocks of fish was carried out, not only in Lake Victoria, but in Lakes Albert and Edward and in many smaller lakes. Experimental fishing, using new fishing methods, has also been done, with results so promising commercially that the Native Administration has now started a fishery, using the new methods to supply, in the first instance, the labour force engaged in the Owen Falls Dam scheme.

48. Observations are also being made on a fish, one of the Haplochromis groups, which occurs naturally in Lake Victoria. This, as a preferential mollusc eater, may find important application in the control of certain human and stock diseases caused by parasites, in the life-history of which molluscs are intermediate hosts.

49. The Mauritius-Seychelles Fisheries Survey ended in December, 1949, and the research vessel is now in process of refitting pending her re-employment on other work. Besides the exploration of the fishing banks, a full-scale research has been done on the principal species, their feeding and breeding habits, and their abundance. This will provide material for an estimate of the rate of production of fish on these banks, and therefore of the amount of fish which could be caught annually without the risk of over-fishing. Preliminary results suggest that the amount may be a high one.

50. The results are now being worked up for publication ; but already two commercial concerns are preparing to exploit them. There is every reason to believe that the Survey, which costs some £30,000, may result in the winning of some £100,000 worth of fish annually from the fishing banks explored. It is interesting to note that, on these banks, the pelagic or surface fishes, such as tunnies, are rare, and that bottom-living fish are plentiful, in contrast with the coast of East Africa, where the reverse appears to apply.

51. Analyses of many samples of shark and other liver oils have given disappointing results, and samples rich in vitamin A have been the exception.

52. The final results of the Gulf of Aden Fisheries Survey have now come in, and the report on the mission is in preparation for publication. A surprise result was the richness in vitamin A of shark livers from the coast of British Somaliland. Several samples in excess of 30,000 units per gramme were found. There also appear to be possibilities of developing sponge fisheries (for industrial sponges) and the canning of crabs, on the Somaliland coast.

53. The first report on the Fisheries Survey in Sarawak has been received. Using a diesel driven fishing craft, it has been shown that the catch of fish in unit time by the Danish seine is as high as in the North Sea. Unfortunately, it proved impossible to put in the amount of sea-time necessary to make this method a commercial success. Better results were got with heavy long lines, and still better results with fish traps in deep water. Indeed, the vessel was in February, 1950, catching an average weight of 2,000 lb. of first-class fish per week by traps, her earnings being £100 weekly against expenses of £30. Shark livers were found to contain the interesting vitamin A content of 17,000 I.U. per gramme ; and experiments in producing fish meal from sharks were successful, the product attracting keen interest from the Chinese as pig and poultry food.

G. Geodetic and Topographical Surveys

54. The work of the Directorate of Colonial (Geodetic and Topographic) Surveys was again directed mainly to the preparation of maps of specific areas scheduled for immediate development, but some progress has also been made in the preparation of standard topographic series.

55. *Directorate Establishment.* The establishment has grown steadily though slowly ; the Directorate is not yet up to full strength in surveyors, computers or cartographers. During the year the establishment for cartographers has been agreed with the Treasury and the first two stages, Nomination and Limited Competition, have been completed. Arrangements are being made for the third stage, Open Competition, to take place shortly. In all, 91 members of the cartographic grades have satisfied the Civil Service Commissioners as to their qualifications for establishment. The establishment for surveyors and photographers has also been agreed with the Treasury : two photographers have been established, and one surveyor has been interviewed by the Civil Service Commissioners. Negotiations for the establishment of the computing staff are still continuing.

56. *Field Work.* Field work has been continued in Uganda, Kenya, Tanganyika, Northern Rhodesia and Nyasaland. The work begun in Swaziland in May, 1948, was completed. Work has been taken up in British Guiana, North Borneo and Bechuanaland.

57. Air photography was continued by the Royal Air Force in Africa by radar-controlled navigation and in Malaya by visual navigation. In spite of adverse weather, approximately 63,000 square miles were covered in East and Central Africa by August, after which the squadron moved across to West Africa.

58. In West Africa the weather was again adverse. Some 32,000 square miles were covered, including the re-photography of certain areas in the Gold Coast and Nigeria. Photography ceased in West Africa at the end of December, and the squadron moved back to East Africa to catch the weather in Uganda and Kenya. Good progress has been made and the squadron is about to move southwards to Tanganyika and the South African High Commission Territories. Arrangements are in hand for the squadron, which is operating in South-East Asia and has completed its immediate work in Malaya, to start a programme in North Borneo and Sarawak.

59. *Mapping.* The main mapping effort has been directed to production of "preliminary plots" at a scale of 1 : 50,000, each plot covering 15 ft. of latitude by 15 ft. of longitude ; in all 84 preliminary plots have been published. Fifty other maps have been published, including 15 sheets at scale 1 : 5,000, mainly township maps containing a great deal of detail, seven sheets at 1 : 500,000

of the Falkland Islands Dependencies, and a number of small scale maps for special purposes.

60. Production of " preliminary plots " in hand totals 342 sheets, of which 127 are nearing completion and 125 are actually in the printing stage. One sheet has been published at scale 1 : 62,500 fully contoured and in colour, and drawing has commenced for 33 others. It is intended to bring out a revised edition of all the maps in the Colonial Office List Map Supplement and work has begun. A large area in Malaya has been mapped for defence purposes in conjunction with the War Office.

H. Geological Survey

61. During the year the recruitment of geologists improved very considerably, resulting in more than forty appointments, so that it is now possible to see the beginning of the expansion of the existing Geological Surveys in Kenya, Uganda, Tanganyika, Nyasaland, Nigeria, the Gold Coast, Sierra Leone and British Guiana ; in addition, two new surveys were formed in Jamaica and in the British Territories in Borneo (North Borneo and Sarawak). In Malaya, the Geological Survey was still one short of the pre-war establishment. There have been resignations and deaths, but the total strength of the overseas scientific staff in Colonial Geological Surveys has increased from 73 to 110 during the year under review.

62. Two experienced European geologists not of British nationality were appointed on contract for three years. Practically all of the British and Commonwealth geologists were appointed on probation with a view to being given permanent and pensionable terms, but most of these were new graduates. It will still be some time before there will be sufficient experienced men available to enable new geological surveys to be made in Aden, British Honduras, the British Solomon Islands Protectorate, Fiji, Hong Kong and the Somaliland Protectorate. It is hoped shortly to begin operations in Cyprus and Northern Rhodesia. During the latter half of the year, a geological survey of Mauritius was carried out by a party from Cape Town University under the leadership of Professor F. Walker. The geological survey of an area where mineral deposits are possible in British Honduras will be effected through the secondment of an experienced geologist from British Guiana when one can be spared, and, similarly, it is proposed that an investigation of the mineral deposits in Hong Kong shall be undertaken with help from Malaya.

63. The main purpose of geological surveys in the Colonies is to prepare geological maps and in so doing to take the essential first step in the investigation of mineral resources. Geological Survey departments have been in existence in certain Colonies for many years, but until recently their staffs have been small and occupied mainly with routine work and short-term investigations of immediate importance to the Governments concerned ; few geologists have been made available for the important long-term task of geological mapping. The expansion of the departments which has now begun ensures that the mapping programme is beginning to receive adequate attention. The provision of topographic maps by the Directorate of Colonial (Geodetic and Topographic) Surveys will furnish the basis on which to work ; that Directorate has also undertaken in certain cases to provide the Geological Surveys with " preliminary plots," which, with air photographs of the country, will be of great assistance pending receipt of the finished topographic maps.

64. The Directorate of Colonial Geological Surveys has assisted in the recruitment of new staff for the Geological Surveys overseas. Since the Directorate was founded early in 1947, all universities in the United Kingdom

with departments of Geology and most of those in the Commonwealth overseas have been kept informed regarding staff requirements and conditions of service, and, in addition, the Geology departments of most of the United Kingdom universities have been visited by members of its staff. During the same period, the Director (Dr. F. Dixey, C.M.G.) has visited most of the Colonial territories of interest from the point of view of mineral development in order to consult Geological Surveys and Senior officers of the Administrations, and to advise on the inauguration of new Geological Survey departments where none already existed. During the year he visited South Africa to attend the African Regional Scientific Conference and he presented a paper there. He presided at Accra over the first of the West African Inter-territorial Geological Conferences, to which an international element was introduced by the presence of a representative of the French Services des Mines de l'Afrique Occidentale. Afterwards Dr. Dixey visited places of geological interest in the Gold Coast, Nigeria and Sierra Leone. The Directorate has arranged courses of instructions for Colonial geologists on leave and for those newly appointed, and in this it owes much to assistance given by the Imperial College of the University of London.

65. In April, 1949, the Colonial Office assumed responsibility for the scientific work of the Imperial Institute, of which the Mineral Resources Department became the Mineral Resources Division of the Colonial Geological Surveys. The staff of the Division is to be increased so as to enable it to deal effectively with the increased volume of work expected from the expanded Geological Surveys overseas. The Division is responsible for the production of " Colonial Geology and Mineral Resources ", a Quarterly Bulletin serving as the Journal of the Colonial Geological Surveys.

66. The Directorate has set up a Photogeological Section at the Directorate of Colonial (Geodetic and Topographic) Surveys, with the object of producing preliminary geological maps based on air photographs ; one geologist has been appointed, and provision has been made for additional staff. The intention is to provide the Colonial Geological Surveys with photogeological maps of areas in which they are specially interested, and thus to enable them to economise field-work and to concentrate on areas that may contain mineral deposits.

67. The hope expressed in paragraph 54 of last year's Report that a number of American geologists would be secured through the Economic Co-operation Administration has unfortunately proved slow of fulfilment, but it is hoped that a few will be recruited in the near future.

I. Meteorology

68. Since the decision was taken in 1947 to establish separate Colonial meteorological services covering suitable geographical areas, steps have been taken to promote the building up of such services in West, East and Central Africa. Discussions are still proceeding on the ultimate form to be taken by the services in the West Indies and in the Malayan area, which are in the meantime being carried on on a moderate scale by separate civil and military organisations. The administrative and financial difficulties which have delayed the growth of the various services are not yet over and these, together with the shortage of suitable recruits which has been the common post-war experience of most technical services, have acted as a severe brake on pure research work.

69. One general development is a contribution to the study of worldwide upper wind movements. Radio sonde/radar wind stations are in operation or planned in the Falkland Islands, West Africa, East Africa, Singapore and Hong Kong. As regards individual territories, increasing emphasis is being

laid on meteorological research in the work of the Falkland Islands Dependencies Survey. In East Africa, although no organised programme of research has been possible, *ad hoc* climatological investigations have been made into the possibility of establishing a lac insect industry in the region, and a cotton processing industry in Uganda. The Royal Observatory, Hong Kong, is gradually rebuilding its widespread pre-war service to the South China Sea area.

J. Oceanography

70. On the 1st April, 1949, the work of the Discovery Committee was taken over by the National Institute of Oceanography under the aegis of the Admiralty. At the end of the year under review preparations had been made for the R.R.S. "Discovery II" to leave for the South Indian Ocean on an eighteen months' voyage of oceanographical research, with Dr. H. F. P. Herdman as Chief Scientific Officer.

K. Road Research

71. Mr. H. W. W. Pollitt, of the Road Research Laboratory of the Department of Scientific and Industrial Research, was appointed Colonial Road Research Liaison Officer at the Laboratory at the end of the year. Mr. Pollitt went to West Africa in an advisory capacity in 1946 and 1948, and his report on his visits is being published in the Colonial Research Publications series. It is intended that he shall visit the various areas in the Colonial Empire to gain first-hand knowledge of local conditions and to make contact with the Colonial official correspondents with the Laboratory.

L. Tsetse Fly and Trypanosomiasis Research

72. The Tsetse Fly and Trypanosomiasis Committee reviewed its membership and functions at the beginning of the year and subsequently made certain recommendations to the then Secretary of State. These recommendations were accepted and as a result the Committee has been reconstituted with the following terms of reference :—

> "To consider and advise on the co-ordination of action, including research and reclamation, directed against human and animal trypanosomiasis".

The range of experience possessed by members of the Committee has been widened by the appointment of an expert on game, a proto-zoologist, a zoologist and the Directors of the East African Tsetse and Trypanosomiasis Research and Reclamation Organisation and of the West African Institute for Trypanosomiasis Research. In addition, a joint Sub-Committee of the Tsetse Fly and Trypanosomiasis Committee and the Colonial Advisory Council for Agriculture, Animal Health and Forestry has been set up to consider game questions and, in particular, what research is required in relation to them.

73. The West African Institute for Trypanosomiasis Research, because of the scarcity of people with experience in this particular field, is at present staffed largely by young and relatively inexperienced workers. The Director has therefore devised a programme which will serve the dual purpose of training new recruits and acquiring scientific knowledge of practical importance. The programme covers work in entomology, epidemiology, protozoology and the veterinary field. Those parts of it which are not yet operative will be put into effect progressively as various buildings of the Institute are completed and equipped. In the Director's view, in the development of the West African Colonies the study of animal trypanosomiasis must take precedence over human trypanosomiasis which can already be largely controlled by means

already available. He also feels that the ultimate solution of the problem will be achieved by the application of a combination of a number of different methods rather than by any single method alone. For this reason, all the four lines of research mentioned above must be pursued.

74. The East African Tsetse and Trypanosomiasis Research and Reclamation Organisation is embarking upon a new programme of tsetse research, making use of methods which have been recently evolved. The ultimate object of the programme is the development and refinement of survey techniques necessary for the proper planning of reclamation measures. A programme of trypanosomiasis research continues at Tinde pending the final decision to construct a Central Research Institute at Sukulu, and the Tsetse Reclamation Department has produced a new programme which places the emphasis on experimental and advisory services.

75. The visits of two representatives of the United States Economic Co-operation Administration to East and West Africa during the year produced a number of useful proposals for additional research with dollar assistance which are being given attention.

76. In all the research work the economic possibilities of the results, and the economic results which it is desired to achieve, are kept in mind. These points were given prominence at the British African Land Utilisation Conference held at Jos, Nigeria, in November, 1949, where it was emphasised that the ultimate goal is to free or reclaim lands from tsetse or the risk of sleeping sickness and that the importance of the development of new techniques should not be allowed to obscure the desirability of making the fullest possible use of those already available. The experts on tsetse and trypanosomiasis who attended that Conference laid emphasis on the existence of such techniques and the importance of using them in the pilot schemes of resettlement and agricultural development advocated by the Conference.

77. A number of experiments have been carried out with Antrycide, chiefly with the object of discovering its prophylactic value. It is not yet possible to evaluate these results, but the difficulties in the way of prophylactic application must of necessity be great, and it is important that they should not be allowed to obscure the great potential value which further research into its curative properties could have. A satisfactory prophylactic technique would of course solve both the problem of settling cattle in tsetse infested areas where they do not at present live, and the problem of trypanosomiasis in existing herds in areas not infested by fly. The latter problem is, however, most pressing, if existing herds are to be maintained.

78. In the field of international collaboration, the Standing Trypanosomiasis Bureau at Leopoldville-Brazzaville, which commenced to function in March, 1949, has produced a steadily increasing flow of literature for the information of field and laboratory workers in all areas where there is an interest in trypanosomiasis work, and it is to be hoped that as time passes it will become widely recognised as a valuable focus of such information.

79. The International Scientific Committee for Trypanosomiasis Research is due to hold its second meeting in June, 1950, when the delegates will be the guests of the Belgian Government. The object of this, as of the first meeting of the Committee, is to bring together scientists actively engaged in trypanosomiasis work in order that they may review recent field and laboratory progress, and stimulate further research at discussions besides promoting co-ordination between research organisations in different countries.

M. Water Pollution Research

80. During the year forty correspondents with the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research have been nominated by Colonial Governments. As a result, the number of requests for information and assistance received by the Laboratory from Colonial territories has greatly increased. Enquiries have been received on a wide range of problems, including the treatment of difficult waters for supply, the treatment of trade waters, and the prevention of pollution of rivers. Much interesting information on the conditions of water supply and waste disposal has also been received by the Laboratory. In addition, visits have been paid to the Laboratory by a number of the officials nominated or by members of their staffs.

APPENDIX I

Table I

LIST OF SCHEMES APPROVED FOR RESEARCH GRANTS UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS DURING THE PERIOD 1ST APRIL, 1949, TO 31ST MARCH, 1950

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
324	General	Sterling expenditure incurred in connection with United States Economic Co-operation Administration assistance.	10,000
328 328A	do.	Appointment of an officer to take charge of termite research in the Colonial Empire (2 years).	4,650
331	do.	Appointment of a statistician and ancillary staff to undertake an analysis of the responses of tropical crops to fertilisers (3 years).	4,240
57C 57D	do.	Studies by Dr. C. Leubuscher of the location of processing industries (supplementary provision).	340
258A 258B	do.	Studies by Miss I. Greaves of Colonial monetary systems (supplementary provision).	1,470
340	do.	Provision for six post-graduate studentships for two years' training in Insecticides research (2 years).	7,000
198B	do.	Social science research studentships (supplementary provision).	2,250
356 356A	do.	Fundamental research on Colonial insecticide problems to be carried out at the Field Station of the Imperial College of Science and Technology (3 years).	8,460
357 357A	do.	Fundamental research on Colonial insecticide problems to be carried out by the Department of Insecticides and Fungicides, Rothamsted Experimental Station (3 years).	6,015

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
360	General	Overhaul and refitting of research vessel employed on Mauritius-Seychelles fisheries survey prior to undertaking other work.	625
361	do.	Colonial Medical Research Studentships: revised scheme, in replacement of Scheme R.124 (3 years).	7,200
367	do.	Production and publication of reports in the "Colonial Research Publications" series.	4,000
371	do.	Appointment of a Colonial Liaison Officer at the Pest Infestation Laboratory of the Department of Scientific and Industrial Research (5 years).	15,000
375	do.	Appointment of a Colonial Liaison Officer and a part-time technical assistant at the Road Research Laboratory of the Department of Scientific and Industrial Research (3 years).	12,600
346B 346C	do.	Experiments in United Kingdom on dissemination of insecticides from aircraft (supplementary provision).	1,040
76B	do.	Appointment of Secretary to the Committee for Colonial Agricultural, Animal Health and Forestry Research (supplementary provision).	700
247B	do.	Contribution towards maintenance of the work of the London Office of the British Commonwealth Scientific Offices during 1950/51.	779
376	do.	Production and publication of report in the "Colonial Fisheries Research Publications" series.	2,000
379	do.	Research at the Lister Institute of Preventive Medicine into the preparation of precipitin sera for entomological investigations of malaria, trypanosomiasis, etc. (in continuation of Schemes R. 295 and 302).	5,813
381	do.	Assistance towards cost of publishing reports recommended by the Colonial Advisory Council of Agriculture, Animal Health and Forestry.	1,000
383	do.	Survey by Dr. C. Leubuscher of data relating to food imports and production, and consumption in the Colonial territories.	600
384	do.	Research by Miss E. H. Slifer into locust physiology (2 years).	1,425

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
387	**General**	Formation of a small pool of entomologists to undertake short-term investigations in the Colonies, especially in smaller territories which have no Government entomologist on their establishments (5 years).	20,000
97A	do.	Appointment of Secretary to the Colonial Social Science Research Council (supplementary provision—3 years).	3,040
51B	do.	Continuation of work of the Anti-Locust Research Centre for 5 years.	90,000
241C 241D	do.	Continuation of work and new work by other anti-locust research workers.	8,340
391	do.	Research by Mr. R. E. Robinson into the history of British administration in Africa (2 years).	1,000
393	do.	Appointment of a Fish Taxonomist for work in the Colonial Empire (5 years).	6,000
165A	**Africa, General** ...	African linguistic studentships (supplementary provision).	700
28B	do.	Preparation of Handbook of African Languages: provision for 1949/50.	2,283
41C 41D	do.	Ethnographic Survey of Africa (supplementary provision for three years 1950/51 to 1952/53.)	15,145
237A	do.	Linguistic research: survey of the North Bantu borderland (supplementary provision).	450
309A	do.	Research by Mr. J. S. Perry into the embryology and reproduction of the African elephant (supplementary provision).	225
325	**East Africa, General**	Formation of a Filariasis research unit. (Grant covers £6,000 for capital expenditure and £41,000 in respect of two-thirds of recurrent expenditure over 5 years; the balance of the recurrent expenditure is being met by the East African Governments.)	47,000
330	do.	Establishment of an East African Scientific and Industrial Research Organisation. Appointment of a Director for five years. (Grant covers £5,000 for capital expenditure and £13,333 in respect of two-thirds of the recurrent expenditure; the balance is being met by the East African Governments).	18,333

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
344	**East Africa, General**	Provision for establishment of headquarters in Tanganyika of the East African Insecticides Research Unit.	55,000
386	do.	Continuation of the work of the East African Insecticides Research Unit for 3 years (1950-1952)	74,000
68I 68(*a*)A	do.	Insecticides research. Dissemination of insecticides from aircraft, and further experimental work in England (supplementary provision).	3,500
337	do.	East African Virus Research Institute, Entebbe: appointment of a Director (preliminary provision for 5 months).	800
338	do.	East African Virus Research Institute, Entebbe: appointment of a Zoologist (preliminary provision for 5 months).	575
377	do.	East African Virus Research Institute, Entebbe: provision for maintenance during period 1.1.50–31.3.50.	6,230
395	do.	East African Virus Research Institute, Entebbe: assistance towards expansion and maintenance during the 5 years 1.4.1950–31.3.1955. (Grant covers 100% capital expenditure and 75% of the recurrent expenditure; the remaining 25% is being provided by the East African Governments.)	150,000
301A	do.	East Africa Agriculture and Forestry and East African Veterinary Research Organisations (supplementary capital provision).	21,000
151C	do.	East African Virus Research Institute, Entebbe (supplementary provision for 1949).	1,965
147F	do.	East African Virus Research Institute: employment of Dr. W. H. R. Lumsden (supplementary provision).	1,300
334	do.	Construction and equipment of an East African Herbarium at Nairobi.	10,500
244A	do.	East African Bureau of Research in Medicine and Hygiene (supplementary provision).	250
126C	do.	Establishment of headquarters for the East African Tsetse Reclamation Department and East African Tsetse Research and Reclamation Unit (supplementary provision).	6,330

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
126D	**East Africa, General**	Provision for salary of Director of the East African Tsetse and Trypanosomiasis Research and Reclamation Unit and other headquarter expenses (3 years). (Grant covers two-thirds of the estimated expenditure; the remaining one-third is being met by the East African Governments.)	11,114
216A 216B	do.	Research into ecology of predators and hosts of the tsetse fly (supplementary provision).	1,017
355	do.	Establishment of an East African Malarial Unit (5 years). (Grant covers one-half of £16,500 capital expenditure and one-quarter of recurrent expenditure estimated at £45,000. Balance is being defrayed from the East African regional allocation of Colonial Development and Welfare funds and from contributions made by the East African Governments.)	19,500
365	do.	Appointment of a Scientific Secretary to the East Africa High Commission—in replacement of Scheme R.105 (3 years). (Grant covers one-half of the estimated cost; the other moiety is being defrayed by the East African Governments.)	7,560
173F	do.	Medical research in East Africa. Visit of Professor G. Macdonald, Ross Institute of Tropical Hygiene (supplementary provision).	530
178D	do.	Research into relapsing fever by Dr. G. A. Walton (supplementary provision).	1,000
373 374	do.	Experiments with dissemination of insecticides from fixed-wing aircraft.	65,000
392	do.	Establishment of an East African Marine Fisheries Research Survey in Zanzibar. (Grant covers 100% of the capital expenditure estimated at £33,000 and 50% of the recurrent expenditure estimated at £86,000 over 5 years; the other moiety is being defrayed by the East African Governments.)	76,000
354	**East Africa and Middle East**	Assistance towards establishment of the Desert Locust Survey. (Grant represents 12% of the estimated cost during the period 1948–50.)	12,123
368	**East Africa and Mauritius**	Visit by Dr. P. C. C. Garnham to assess results of residual spraying trials with insecticides.	600

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
252B	**Kenya**	Sociological research by Mr. P. H. Gulliver (supplementary provision).	300
388	do.	Sociological research by Mr. and Mrs. A. Harris (2½ years).	6,350
389	do.	Sociological research by Miss J. M. Fisher (2½ years).	3,975
335	**Uganda**	Sociological research by Mr. F. K. Girling (3 years).	3,990
351	do.	Sociological research by Mr. J. F. M. Middleton (2 years) (in supplementation of financial assistance provided from other sources).	950
385	do.	Sociological research by Mr. E. H. Winter (2½ years).	4,750
390	do.	Sociological research by Mr. B. K. Taylor (2½ years).	4,150
366	**Somaliland Protectorate**	Linguistic research by Mr. B. Andrae-jewski (1¼ years).	2,050
343	**Central Africa, Northern Rhodesia**	Establishment of a Tsetse Fly Research Unit (4 years). (Grant is being supplemented by contribution of approximately £10,000 from the Northern Rhodesia Government.)	16,616
345	do.	Sociological research by Mr. A. L. Epstein (1¼ years).	1,640
187D	do.	Maintenance of Rhodes-Livingstone Institute, 1949 (supplementary provision).	1,325
370	do.	Assistance towards continuance of work of Rhodes-Livingstone Institute for a further period of 5 years. (The total cost is estimated at £130,000; the balance is being contributed from various sources in Central Africa and elsewhere.)	100,000
394	**Northern Rhodesia and Nyasaland**	Establishment of a Fisheries Research Organisation to serve Northern Rhodesia and Nyasaland. (Grant covers 100% of the capital expenditure estimated at £35,000 and 50% of the recurrent expenditure estimated at £54,000 over 5 years; the other moiety is being defrayed by the two Governments.)	62,000
323	**West Africa, General**	West African Virus Research Institute, Lagos: appointment of an entomologist for 3 years.	3,880
348	do.	West African Virus Research Institute, Lagos: appointment of an Acting Director.	1,300

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
382	**West Africa, General**	West African Virus Research Institute, Lagos: expansion and maintenance for 5 years. (Grant covers £49,000 for capital and £151,000 in respect of one-half of the estimated recurrent expenditure; the other moiety of the latter is being defrayed by the West African Governments.)	200,000
326	do.	Establishment of a West African Institute of Social and Economic Research. Grant to cover erection of buildings and appointment of a Director for 5 years.	53,000
140A	do.	West African Institute for Tsetse and Trypanosomiasis Research (supplementary provision).	3,900
90E	do.	West African Pest Infestation Survey (supplementary provision).	2,280
332	do.	Enquiry by Mr. P. Bauer into the organisation and structure of trade in West Africa (15 months).	2,700
347	do.	Establishment of a West African Road Research Laboratory (3 years). (Grant covers £1,000 capital expenditure and 50% of recurrent expenditure; the other moiety of the latter is being defrayed by the West African Governments.)	5,575
352	**Gambia**	Sociological research by Mr. D. P. Gamble (2 years).	2,700
320	**Nigeria**	Sociological research by Mr. M. G. Smith and Mr. E. W. Ardener (2 years).	5,170
109B 109C	do.	Hot climate physiology research by Dr. W. S. Ladell (supplementary provision—2 years).	11,839
339	do.	Historical research by Mr. K. O. Dikè	350
342	do.	Sociological research by Mr. W. B. Schwab (2 years).	3,400
322A	do.	Research into the incidence of loiasis (supplementary provision for capital expenditure).	9,300
378	do.	Research by Dr. J. Schacht into recent developments of Islamic law in Northern Nigeria.	475
359	do.	Fundamental insecticides research at University College, Ibadan (3 years).	7,000

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
322	**Nigeria** (Cameroons—British Section)	Helminthiasis research, Investigation of the incidence of loiasis by a team of research workers (3 years). (Grant covers £5,250 for capital expenditure and £9,725 representing 50% of the recurrent expenditure; the other moiety is being defrayed by the Nigerian Government.)	14,975
341	**Sierra Leone** ...	Sociological research by Mr. G. R. Collins and Miss E. M. Richardson (2 years).	3,380
195B	**South African High Commission Territories, Basutoland**	Land tenure survey by Mr. V. Sheddick (supplementary provision).	110
214C	**Middle East, Aden**	Survey of the Gulf of Aden fisheries (supplementary provision).	300
67C	do.	Survey of social and economic conditions in the Aden Protectorate by Mrs. W. H. Ingrams (supplementary provision).	66
88J	**Indian Ocean, Mauritius and Seychelles**	Mauritius-Seychelles Fisheries Survey (supplementary provision).	1,200
319	**South-East Asia, General**	Visit of an advisory mission to report on the practicability of the regional organisation of agricultural, animal health and forestry research.	1,600
288A	do.	Establishment of an Institute for research and training in fish farming at Penang (supplementary provision).	2,544
288B	do.	Maintenance of the above Institute for 5 years	137,000
327 327A	**Federation of Malaya**	Experiments with synthetic insecticides (3 years).	13,850
349	do.	Construction and equipment of an hydraulic laboratory for the Department of Drainage and Irrigation. (The maintenance and recurrent costs of the laboratory will be financed by the Federation of Malaya Government).	23,334
362	do.	Visit of an agronomist and an agricultural engineer to advise on problems of soil management and mechanised cultivation in connection with the extension of rice production.	910
177C	do.	Scrub typhus research (supplementary provision for 2 years).	11,151

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
115C	**Federation of Malaya**	Malaria research: experiments with paludrine (2 years). (Additional expenditure, estimated at about £1,000, is being defrayed by the Federation of Malaya Government).	2,112
380	do.	Leprosy research by Dr. R. S. Airey (4 years). (Grant represents 50% of the anticipated expenditure; the other moiety is being contributed by the Federation of Malaya Government.)	7,250
209A	**Sarawak**	Fisheries survey (supplementary provision).	3,125
321	**North Borneo** ...	Sociological research by Miss M. Glyn Jones (2 years).	2,600
158C	do.	Malaria research by Dr. J. McArthur (supplementary provision).	697
372	**Singapore**	Sociological research by Mr. A. J. A. Elliott (2 years).	3,715
251B 251C	**West Indies, General**	Establishment of the West Indies Institute for Social and Economic Research (supplementary provision—5 years).	74,800
236C 236D	do.	Establishment of the Colonial Microbiological Research Institute (supplementary provision—2 years).	30,300
11A	do.	Survey of West Indian fisheries (supplementary provision).	124
197(*a*)A 179A 159A 175A	do.	Research on bananas, soils, cocoa and sugar technology at the Imperial College of Tropical Agriculture (supplementary provision for capital expenditure).	31,912
145E	do.	West Indian sociological survey (supplementary provision).	257
369	do.	Visit of Sir Arnold Plant in an advisory capacity to West Indies Institute of Social and Economic Research.	460
336	**British Guiana** ...	Assistance towards the expansion and operation of the Ebini Livestock Experimental Station. (Grant represents two-thirds of the estimated total cost: the remaining one-third is being defrayed from British Guiana funds).	18,813
201B	**British Honduras** ...	Visit of expert to explore possibilities of cassava starch production (supplementary provision).	2
358	do.	Experimental tapping of turpentine and resin.	180

Scheme No. (Prefix 'R')	Benefiting Territory	Description of Scheme	Amount
			£
82E 82F	**Jamaica**	Experiments with gas refrigeration of bananas (supplementary provision).	2,725
93C(*b*)	do.	Sociological research by Mr. Deans Peggs (supplementary provision).	870
364	do.	Malaria research by Dr. R. C. Muir-head-Thomson (2 years).	5,550
329	**Trinidad**	Visit of Dr. R. W. G. Dennis, Royal Botanic Gardens, Kew, to study tropical fungi and fungal diseases.	250
350	do.	Malaria research by Mr. R. A. Senior White (2 years).	4,205
333	**Mediterranean Cyprus**	Research to ascertain causes of the swarming of the Moroccan locust and the best means of prevention (5 years). (Grant covers £1,900 for capital expenditure and two-thirds of estimated recurrent expenditure of £4,700 p.a.; the balance is being defrayed by the Cyprus Government.)	17,600
353	**Pacific, Fiji** ...	Preliminary survey of anaemias and dental diseases.	433
363	**Fiji and Western Pacific**	Establishment and maintenance of an Institute of Educational Research to serve Fiji, the British Solomon Islands Protectorate and the Gilbert and Ellice Islands Colony (5 years). (The total cost of this scheme is estimated at £29,440; the balance is being contributed by the Fiji Government.)	21,017
		TOTAL	£1,795,999

Table II

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

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*

Notes :—

The majority of the allocations are in respect of schemes extending over more than one year. For actual expenditure see Table III.

* These figures include the expenditure incurred up to 31st March, 1950, and totalling £98,620 on Scheme R.7 (work of the Colonial Products Research Council). See Appendix II, Cmd. 6486.

Table III

ACTUAL ISSUES IN RESPECT OF RESEARCH SCHEMES, 1940–50

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	425,761
1948–49	763,300
1949–50	1,284,311
Total	£2,845,325

Colonial Products Research Council Seventh Annual Report (1949-1950)

Ministry of Labour,
80-82, Pall Mall,
S.W.1.
4th May, 1950.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Products Research Council for the year 1949-50.

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

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

COLONIAL PRODUCTS RESEARCH COUNCIL

Membership

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

MR. ERIC BARNARD, C.B.E., D.S.O., M.A., Deputy Secretary, Department of Scientific and Industrial Research.

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

MR. ANEURIN DAVIES, Co-operative Wholesale Society.

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

PROFESSOR SIR NORMAN HAWORTH, Sc.D., LL.D., F.R.S., Emeritus Professor of Chemistry, University of Birmingham.

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.

LT. COL. H. J. HOLMAN, B.Sc. (*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 organizations, 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
SEVENTH ANNUAL REPORT

CONTENTS

COLONIAL PRODUCTS RESEARCH COUNCIL

SEVENTH ANNUAL REPORT

PART I. GENERAL

During the year the Council has learned with the deepest regret of the death of two of its original members—Sir Norman Haworth and Mr. G. Thomson. Prior to September, 1949, Sir Norman Haworth, Director of the Chemical Laboratory in the University of Birmingham, was responsible for the supervision of the experimental work on sugar and starch, and the Council owes much to his wise guidance and to his profound knowledge of organic chemistry. The very heavy demand on Mr. Thomson's time had prevented him attending the Council as frequently as he would have wished, but in its early days he took great interest in the work and was of great assistance in helping to direct the course of the Council's work.

2. Sir Edward Mellanby resigned from the Council on his relinquishment of the post of Secretary, Medical Research Council. The Secretary of State appointed Dr. H. G. Thornton, F.R.S., Rothamsted Experimental Station, and Professor E. R. H. Jones, F.R.S., Professor of Organic Chemistry in the University of Manchester as members of the Council.

3. The Council has learned with much pleasure of the election of Professor Jones to the Fellowship of the Royal Society, and the award by the Society of the Davy medal to Professor Todd.

4. It was recorded in the last Report that the Director of Research, Sir John Simonsen, F.R.S., had been selected by the American Chemical Society as the first recipient of the Fritzsche Award. This award was established to "recognise and encourage oustanding achievement in analysis, research and new applications of essential oil isolates and related chemicals". Sir John visited the United States on the 16th to 28th September and attended the autumn meeting of the American Chemical Society at Atlantic City, where he was presented with the Fritzsche Award. Sir John then travelled to Ottawa on the 29th September at the invitation of the National Research Council of Canada, and gave two lectures, one relating to the work of the Colonial Products Research Council and the other on terpene chemistry. He also had an opportunity of visiting the laboratories of the National Research Council.

5. In last year's Report reference was made to the opening of the Colonial Microbiological Research Institute in Trinidad, and Dr. Thaysen's report on the first full year of operation is given in para. 43. Unfortunately work in the laboratory has been somewhat handicapped by the development of certain structural defects. Steps have now been taken to get these remedied but this may involve the closing of the laboratory for a short period. A start has been made with the erection of the building to contain the pilot plant. It is anticipated that this will be completed during the year. Certain aspects of the work in progress in the laboratory have already indicated that the plant will be of great value.

6. Work carried out during the year on the fermentation of the cocoa bean and on the nature of the substance or substances responsible for the development of the chocolate aroma have indicated that both problems are complex (para. 43 (b)). A general picture has been obtained of the types of micro-organisms which are active during the fermentation of the cocoa bean in Trinidad and Grenada. It will undoubtedly prove of interest later to determine whether the Gold Coast and Nigerian micro-organisms are the same.

7. The development of the chocolate aroma on roasting the bean would appear to originate in polyphenols and not in the colouring matters, the anthocyanins, present in the bean since these disappear during fermentation. Dr. Forsyth has been successful in identifying the anthocyanins present in the bean, and attempts are now being made to separate the precurser of the chocolate aroma (para. 43 (b) ii and iii).

8. In view of the increased interest in sterol derivatives work is in progress at the Institute on the possibility of certain tropical types of micro-organisms yielding sterols differing in nature from those found in more temperate climates (para. 43 (e)). Amongst the yields so far examined the most active sterol produced is a yeast from the fermenting cocoa bean.

9. The Hankey collection of micro-organisms now comprises 284 species, of which 134 have been isolated at the Institute from tropical habitats. A complete list has been forwarded to the Permanent Committee of the Commonwealth Culture Collection in London and will be published by them. Cultures from the collection have already been widely distributed.

10. The important observation has been made during the year that banana plants resistant to attack by *Fusarium oxysporum cubense*, the cause of the Panama disease, harbour in their root system certain bacteria, which produce antibiotic substances highly active against fungi and other micro-organisms. In the root systems of the Panama disease-susceptible Gros Michel variety of banana such bacteria are apparently absent or very rare. This interesting observation is very suggestive and may lead to new methods of attacking the disease.

11. In 1942, Meredith reported the isolation from a Jamaican soil of an actinomycete which was toxic to the *Fusarium oxysporum cubense*, the cause of the Panama disease of bananas. Following upon further work by Dr. Thaysen and his collaborators, Drs. Arnstein, Cook and Lacey working in the Imperial College of Science and Technology, found that the actinomycete gave a mixture of pigmented strains. From the fluid culture of the red strain an antibiotic, musarin, was isolated which was a powerful antifungal agent but less effective as an anti-bacterial antibiotic.

12. From material provided by Dr. Thaysen, Professor Hassall and Miss L. Wong, working in the University College of the West Indies, have made a further study of Meredith's actinomycete, from which they have separated seven strains (para. 44). Only one of these, a green strain, yielded an antibiotic. This differed completely in its properties from musarin and has been designated, monamycin. It is highly active against gram positive bacteria but it has no activity against gram negative organisms. The Council is gratified to be able to record this promising result of the first joint investigation by the Colonial Microbiological Research Institute and the newly founded University College of the West Indies.

13. Dr. A. C. Thaysen attended the international Union of Biological Sciences in Brussels from the 23rd to 25th May, 1949, where he read a paper on the " Amaerobic Nitrogen Fixing Bacteria ". He also attended the International Congress of Biochemistry at Cambridge from the 19th to 25th August.

14. There is little doubt that there would be much more rapid progress in the industrial utilization of sugar if a convenient method could be found for its conversion into simple homocyclic compounds. A tentative step in this direction has been the preparation by Dr. Wiggins of such a substance by the interaction of two simple substances which can be prepared from sugar. This

work, which is referred to in para. 35, may open up a profitable field of research. Miss R. E. Weston, in collaboration with Professor Frazer, has continued to examine the pharmacology of substances provided by Dr. Wiggins.

15. As a necessary preliminary to the technical utilisation of sugar cane wax attention is being directed to a careful study of its properties. It has been found that the waxes from different varieties of cane have very different properties and not all of them are suitable for industrial use (para. 35).

16. Working in Professor Stacey's laboratory in the University of Birmingham, Mrs. C. E. M. Tatlow has continued her study of new trifluoroacetyl derivatives of the sugars (para. 35). A number of these have been prepared, but although they are highly crystalline, they suffer from the disadvantage that they are readily hydrolised. In collaboration with Messrs. G. T. Bruce and R. J. Bayly, Professor Stacey has studied the chemistry of the sugar alcohols, work closely related to other investigations in this field being carried out by Dr. Wiggins (para. 35).

17. In previous reports reference has been made to a dextran, which is a blood plasma substitute. This is now being marketed under the name "Intradex", and the increased utilization of this substance has brought to light a number of new problems which are being investigated by Professor Stacey. These are referred to in para. 35. It would appear probable that some other dextran derivatives, which have been prepared, may find a use not only in food and bakery technology, but also in the paint and plastics industries, thus extending the commercial uses of sugar.

18. Methods for the separation of amylose and amylopectin from starch have been improved in Professor Peat's department at the University College of North Wales, and it is now possible to produce high quality amylose and amylopectin from potato starch by comparatively simple methods (para. 36). As explained in earlier reports, each of these products has its own industrial uses, and the development of an economic commercial method of their separation would appreciably enhance the value of any starch from which they are derived.

19. As will be seen from the detailed account given in para. 38 Professor Hilditch and his collaborators have very actively continued the investigation of vegetable drying oils. It is now definitely proved that the heat treatment of the oil seeds from *Tetracarpidium conophorum* is successful in preventing the development of free fatty acid in the seeds on storage. This is of fundamental importance since further technical trials have conclusively shown that this oil is superior to linseed oil. It is very satisfactory to be able to record that the experiments which have been in progress in Nigeria on the cultivation of the vine have now proved sufficiently successful for it now to be possible to proceed to the next stage of large scale experimental planting. It will, of course, be a considerable time before this is in full production, more especially since the bulk of the seeds grown in the early stages will be required for further planting. It will, however, be possible during the next few years to estimate the yield per acre of the oilseeds. In the meantime it is hoped that heat-treated seeds from the wild crop may be sent to this country in sufficient quantity to enable the paint and linoleum industries to explore fully the technical uses of this oil.

20. At the request of the Overseas Food Corporation Professor Hilditch has examined the oil from various varieties of groundnuts and sunflower seeds grown in East Africa (para. 38 (b)). The oils have been found to be of high quality.

21. It was suggested in last year's report, para. 28, that environmental conditions may prove to be of greater importance than botanical variety in the composition of the oil from sunflower seeds. The work carried out during the year and recorded in para. 38 (d) has amply confirmed this suggestion. This factor does not appear to have been sufficiently appreciated in the past.

22. The important work carried out in the Liverpool laboratories, in addition to suggesting new sources of drying oils, to which can now be added tobacco seed oil (para. 38 (g)) has also resulted in certain definite criteria being given for the evaluation of such oils. This work has been published recently in the Journal of the Oil and Colour Chemists Association and will undoubtedly prove of great value to the industry and should result in the more effective use of new Colonial oils.

23. Present conditions in Malaya preclude any hope of the economics of the collection of rubberseed for oil being investigated. Some hundredweights of rubberseed oil are now available in this country, and it has been suggested to the Ministry of Food that it should be made available for experiments in fractionation of the oil. A small sample already treated in this way has given interesting results.

24. Candlenuts (*Aleurites triloba*) from different sources have been examined in Professor Hilditch's laboratory and show considerable variation of the proportion of the major constituents of the oil (para. 38 (f)). As mentioned in the last report of the Council, the difficulty of finding a satisfactory method of decorticating the nuts has prevented any large scale production with a view to providing a general purposes oil suitable for the paint industry. The Council therefore arranged for a commercial research organization to conduct experiments on the decortication of candlenuts, but these have shown that no practical economic method is likely to be developed for removing the shells without damaging a significant proportion of the kernels. The investigation was therefore diverted to designing a simple and cheap equipment for cracking the nuts and then separating the shells from the kernels. A prototype machine operated by 1¼ h.p. motor has been produced, capable of handling up to three tons of nuts per hour. The final tests on this machine have had to await the arrival of further supplies of nuts, which have now been received.

25. The investigation of the wetting agents obtainable from certain hydrocarbons present in Trinidad petroleum has been continued by Dr. J. C. Smith and Mr. G. Pickering (para. 34). They have been successful in determing the structure of the sulphonic acids found to be of value.

26. Reference was made in last year's report, para. 34, to the isolation of a saponin from the wood of *Mora excelsa*. Some progress has now been made in the study of this saponin, which is related chemically to substances occurring in *Hydrocotyle asiatica* and also to lupeol occurring in *Dyera costulata* from Malaya, which is being examined in Professor E. R. H. Jones's laboratory (para. 39 (H)).

27. The plant required at Princes Risborough for investigating the possibility of utilising Colonial timbers for the manufacture of hardboard has nearly all been erected and it is anticipated that a commencement can now be made in the study of this important problem.

28. Work has been continued in Professor Clemo's laboratory in an attempt to find new uses for eugenol, the principal constituent of clove stem oil, the distillation of which is of major importance to Zanzibar (para. 33). Since the

problem is one of considerable difficulty up to the present no substance likely to prove of economic value has been obtained. It is undoubtedly very desirable that these investigations should continue, since the oil finds its main use in the manufacture of the flavouring material, vanillin. The manufacture of vanillin from lignin, a by-product of the wood pulp industry is now firmly established in Canada and the U.S.A. It is only currency considerations which prevent the purchase of vanillin from these sources.

29. In two papers which have been published in the Proceedings of the Royal Society an account has been given of the investigation of the germination factor for *Striga hermonthica*. Contrary to the original assumption recorded in these papers this does not appear to be a carbohydrate but its exact nature has not yet been elucidated. It is particularly interesting to record that it is similar to if not identical with the germination factor for *Orobanche* (para. 40).

30. The Council has continued to give active support to the study of plant materials which are reported to be of potential medicinal or insecticidal value. These investigations are summarized in para. 39 and when completed seem likely to be of considerable importance. Justification for supporting work in this field, were it considered necessary, is provided by the recent interest aroused by the use of the seeds of a species of *Strophanthus* as a source of "Cortisone", which has been found to be effective in the treatment of rheumatoid arthritis. The Medical Research Council has sent a small team to West Africa to collect plant material which might prove of value in this connection. The Director of Research had an opportunity of meeting this team prior to their departure and was able to suggest certain materials, the collection of which might be desirable. It is unfortunate that owing to staff difficulties it has not proved possible to revise the preliminary list of Colonial plant materials, prepared by Colonel Holman some years ago. This list has stimulated much research but it is urgently in need of revision in the light of recent work and of suggestions received from the Colonies.

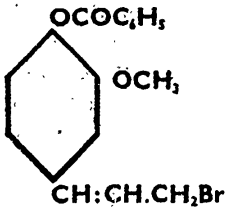
31. Dr. Lythgoe has continued his interesting work on the chemistry of the constituents of the plant, *Hydrocotyle asiatica*, which was reported in France to be of value in the treatment of leprosy (para. 39 (a)). He has recently received a supply of this material grown in Uganda and preliminary results suggest that the constituents present in this, although closely related to, differ from those occurring in the plants grown in Assam and Ceylon. Pharmacological tests which have so far been made do not suggest that the substances isolated are likely to prove of medicinal value.

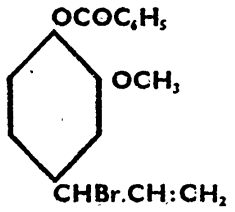
32. The position with regard to natural pyrethrum has undergone a considerable change during the past year. The insecticidal value of the pyrethrum flowers is due to the presence of two constituents, pyrethrin I and pyrethrin II. These are not homogeneous as was first shown by La Forge and Barthel, and the other constituent was designated cinerin I and II. Recently in a laboratory of the United States Department of Agriculture an ester closely related to cinerin I has been synthesised. It is now being produced on a commercial scale and its insecticidal properties are under investigation. Whilst the original estimate of its value was undoubtedly too optimistic there would appear to be little doubt that it, or some other closely related synthetic product will, in due course, prove to be a serious competitor to the natural insecticide. Working under Dr. S. H. Harper's supervision at King's College, Miss N. W. Lowe has prepared a number of standard extracts of the pyrethrins for spectrographic assay with the object of devising a new method of analysis. These samples are now under examination (para. 42).

PART II. REVIEW OF RESEARCH WORK IN PROGRESS

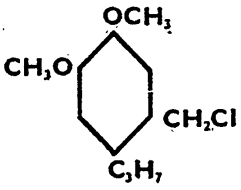
Clove Oil

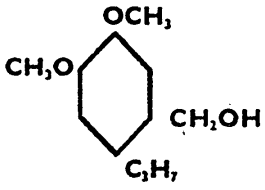
33. (38)* The study of the chemistry of eugenol has been continued in Professor Clemo's laboratory and Mr. P. Lees has examined the action of N-bromosuccinimide on eugenyl benzoate and *iso*eugenyl benzoate and has found that they both yield the same 3[1]-bromo*iso*eugenyl benzoate (I) and not 1-bromoeugenyl benzoate (II). The preparation of new derivatives from this bromo derivative is now in progress.

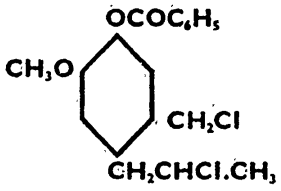




Mr. R. H. Temple has prepared from dihydroeugenyl methylether a chloromethyl compound probably (III) from which the alcohol (IV) has been prepared. He has also obtained the dichlore derivative (V) which is being further investigated.

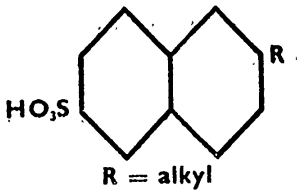






Petroleum

34. (39) Mr. G. Pickering, working in collaboration with Dr. J. C. Smith, has continued his investigations of the wetting agents derived from Trinidad petroleum. He had found that β-*n*-butyl and β-*n*-hexyl naphthalene sodium sulphonates were powerful wetting agents, but the position of the sulphonate group had not been determined. This has now been proved by the conversion of the sulphonic acid into *n*-butylnaphthol identical with a synthetic specimen of 2-*n*-butyl-6-naphthol and it follows therefore that the wetting agents are the sodium salts of 2-alkylnaphthalene-6-sulphonic acids.



Carbohydrates

35. (40) *Sugar.* The investigation of pyridazine derivatives to which reference has been made in previous reports, has been continued by Dr. L. F. Wiggins, and the nitration of 3-amino-6-methylpyridazine has been studied. It has been found that nitration does not occur in the pyridazine nucleus but on the amino group with the formation of 3-nitroamino-6-methylpyridazine. One derivative of this nitroamino, namely 3-(N-diethylaminoethyl)-benzylamino-6-methylpyridazine, is a close analogue of pyribenzamine and it is being studied pharmacologically.

* Figures in parentheses refer to the corresponding paragraph in the 1948-1949 Report.

Work has continued also on sorbitol and mannitol anhydrides and whilst results of some academic interest have been obtained they have not so far indicated any lines of technical development.

More interest attaches to the preparation of the cyclic ketonic acid, 2-acetyl*cyclo*hex-4-ene-l-carboxylic acid, which has been prepared by the condensation of butadiene and β-acetylacrylic acid. This provides a synthesis of a homocyclic compound from sucrose derivatives. The cyclic compound undergoes a number of interesting reactions which are under investigation.

In anticipation of the utilization of the filter mud from the sugar cane factories as a source of wax, the wax from the dried filter mud of a St. Kitts factory is being examined. The principal cane grown in St. Kitts is B.37.161, which contains about 18% of waxy material which can be separated into two fractions, (*a*) a hard wax (70%) and (*b*) a soft fatty fraction (30%). From the latter, after hydrolysis, a crystalline non-saponifiable fraction has been obtained which appears to contain sterol components. An attempt is being made to purify and identify these.

Mrs. C. E. M. Tatlow has continued her study of the trifluoroacetyl derivatives of sugars. A variety of new trifluoroacetates have been prepared from the corresponding hydroxy compounds by treatment with trifluoroacetic anhydride and sodium trifluoroacetate ; *p*-nitrobenzyl trifluoroacetate, m.p. 47° ; dulcitol hexatrifluoroacetate, m.p. 89-90° ; tetra (trifluoro-acetyl) d-methylglucoside, b.p. 158-160° (bath temperature) at 12 mm. $[\alpha]_D^{21^\circ}$ + 88.5° in dry CCl_4 ; tri(trifluoro-acetyl)-1 : 2-mono-acetone glucose, b.p. 163-5° (bath temperature) at 12 mm. $[\alpha]_D^{20^\circ}$ + 15.7° in dry CCl_4. It has been shown that they all undergo alcoholysis in dry methyl alcohol.

The handling of trifluoroacetate esters has been complicated by their ready hydrolysis in the presence of moisture. This instability is reduced somewhat when the compounds are pure. The trifluoroacetates so far investigated are mostly very soluble in all non-polar solvents, some so excessively that recrystallization presents serious problems.

Investigations have been continued also in the 4 : 6-benzylidene α-methylglucoside series.

Further investigations are planned upon the reactions of 4 : 6-benzylidene monotrifluoroacetyl α-methylglucoside and also upon alternative methods of trifluoroacetylation.

Following the work of Dr. Wiggins and Mr. Bourne on triethylidene D-mannitol, Mr. G. T. Bruce and Mr. R. J. Bayly have made a study of the structures of diethylidene D-mannitol and monoethylidene D-mannitol. Techniques involved benzoylation, tosylation, lead tetra-acetate and sodium periodate oxidations, methylation and so on. Of the nine possible formulae for the monoethylidene derivative, it has shown with reasonable certainty that it is the 1 : 3-monoethylidene derivative. The structure of the diethylidene derivative is only partly worked out.

Considerable help has been given in the commercial production by Dextran Ltd., of dextran plasma (Intradex) for blood transfusion and the rate of production is now about four thousand litres per month. A variety of problems has been tackled in the Department, notably on the optimum molecular size of the degraded dextran for transfusion. Material excreted by the kidney following dextram transfusion in the human and in the rabbit is under

examination for (*a*) possible conjugation with proteins, (*b*) molecular size and shape, (*c*) detailed structure. Various methods of degrading the dextran molecule have also been studied.

Various micro-organisms which can convert sucrose into dextran have been studied together with a new bacterial enzyme, obtained from Dr. Hehre of Cornell Medical School, which can convert dextran (1 : 4 α-glycosidic linkages) into dextran (1 : 6-glucosidic linkages). The structure of this new polysaccharide is being examined in conjunction with work on the enzymic synthesis of amylose and amylopectin by the " P " and " Q " enzymes used in conjunction. The " Q " enzyme has been crystallized by Dr. G. Gilbert and Mr. Patrick in the department and shown to be extremely active as a cross-linking agent.

Various derivatives of dextran suitable for extending the commercial uses of this polysaccharide, and hence of sucrose, in food and baking technology, in paints and plastics, etc., have been made and new reference compounds in the methyl sugar series synthesised.

36. (41) *Starch.* Work has been continued by Professor Peat on the enzymic system responsible for the synthesis and degradation of starch. Phosphorylase and the branching factor (Q-enzyme) have been isolated from broad bean and their properties studied. The enzymes are closly related to those previously found in potato, although one or two differences are apparent. The starch of broad bean is also being examined and this is found to be very little different from that of potato. The most striking achievement, however, has been the isolation from the bean of a new type of starch-degrading enzyme. This is being named provisionally, γ-amylase. It has always appeared unusual that none of the enzymes hitherto associated with starch metabolism have been capable of hydrolyzing the branch linkages. Q-enzyme undoubtedly synthesises these branch links (which are substantially 1 : 6-glycosidic linkages), but it appears to be incapable of breaking these links. Similarly, phosphorylase and the two types of amylase generally recognised, namely α- and β- amylases, are without action on the branch links. The new enzyme from bean appears to have the specific function of bringing about the scission of the branch linkages in starch. Furthermore, it has been shown that it operates by a hydrolytic, and not by a phosphorylytic mechanism, and for this reason we are describing the enzyme as an amylase. The full significance of this discovery has not yet been explored but there is considerable evidence that γ-amylase does not have a synthetic function and that therefore it is not a branching factor, like Q-enzyme, acting in reverse. γ-Amylase is isolated very simply by contact of a Q-enzyme preparation with granular starch. The starch adsorbs all the enzymes present with the exception of the γ-amylase. The enzyme is robust and can be kept for prolonged periods as a dry powder. It has practically no action on the amylose component of starch and is thus at once distinguished from the α- and β-amylases and from Q-enzyme. Its action on amylopectin is represented by an increase in the iodine-staining power (B.V.) and at the same time the limit of hydrolysis by β-amylase is much increased.

The methods for the separation of amylose and amylopectin from Starch have been improved. The routine preparation of amylose is now a combination of the methods of precipitation with aluminium hydroxide and thymol extraction. In this way an amylose of high blue value can be prepared from potato starch in any desired quantity. Similarly, amylopectin can be obtained with consistent properties by a purification method which involves perfusion through a cellulose column.

The starch-hydrolysing enzymes of the soya bean have been submitted to close investigation. The chief enzyme present is of the β-amylase type and soya bean has been used for many years as a chief source of this enzyme. It has been submitted to rigorous purification with the object of effecting its crystallization. At the same time, the crystalline β-amylase of the sweet potato, a sample of which was kindly supplied by Dr. A. K. Balls, has been investigated. It has been established that the two enzymes are identical in all essential properties. A comparison between Balls' enzyme and the less highly purified soya preparation used for routine analytical purposes showed that the latter contained in addition to the β-amylase, an enzyme provisionally called Z-factor. The function of the Z-factor was described in a preliminary communication to "Nature". Subsequent to the publication of the letter accumulated evidence strongly suggests that the Z-factor is a phosphatase. It has not been possible to separate the Z-factor in an active form from β-amylase, but the addition of bone phosphatase to the purified soya β-amylase reproduces the action of β-amylase plus Z-factor.

Timber Research

37. (42) (a) *Mora excelsa.* The study of the saponin present in the wood of *Mora excelsa* has been continued by Mr. W. G. Campbell and Dr. R. H. Farmer in collaboration with Dr. D. H. R. Barton. The saponin has been found to yield on hydrolysis a mixture of two triterpenoid hydroxy acids, and not a sterol as had been originally assumed. One of the hydroxy acids is identical with oleanolic acid, whilst the second acid, for which the name morolic acid is suggested, has been shown to be a double bond isomer of oleanolic acid. Morolic acid has been correlated with germanicol, oleanone and dehydro-oleanolic acid.

It has been found that the saponin content of the heart wood of *Mora excelsa* shows considerable variations as is indicated in the following table :—

Tree No.	Height from Ground	Alcohol-soluble material %			Saponin %		
		Centre	Inter-mediate	Outer	Centre	Inter-mediate	Outer
2	48 ft.	9·2	12·7	16·0	6·5	6·3	5·9
3	18 ft.		10·6			2·8–3·5	
6	17 ft.	13·9	16·5	17·6	7·2	7·6	8·4
	36 ft.	14·1	15·9	19·1	6·4	8·1	7·9
	47 ft.	19·4	17·5	16·8	8·1	9·5	9·6
Trinidad	Mora						
Black			17·7			8·3	
White			11·4			8·7	
Red			12·4			6·5	

The heart wood of *Mora gonggrijpii* also contains a saponin in approximately the same amount as that present in the wood of *Mora excelsa.* On hydrolysis the saponin yields a triterpenoid acid, identical probably with oleanolic acid, and two sugars shown by partition chromatography on paper to be glucose and xylose.

(b) Most of the experimental plant for the investigations into the possibility of utilising Colonial secondary timbers for the manufacture of hard board has now been erected. It will therefore be possible to commence work on this subject during the coming year. The delay has not been altogether disadvantageous since Mr. Campbell has been able, in his visits to the United States and France, to see the most recent developments in this field.

Vegetable Oils

38. (43). Professor T. P. Hilditch was assisted by Messrs. C. Barker, A. Crossley, R. V. Crawford and A. J. Seavell. Mr. Seavell, who received the degree of Ph.D. in December, left in October to take up an industrial post. Mr. Bridges was appointed in October.

(a) *Tetracarpidium conophorum.* (Messrs. A. J. Seavell and A. Crossley). At the request of the Board of Trade 2,800 lbs. of heat-treated seeds of *Tetracarpidium conophorum* were sent from Ibadan by Mr. Irving, Agricultural Chemist. Samples of the oil from these seeds on arrival had a free fatty acid value of 0.4%, iodine value 205.4. After a period of three months the oil seeds were sent to the Premier Oil Mills, Hull, to be processed. The oil was solvent extracted but owing to the small amount of seed available losses were relatively large and overheating occurred in removing the solvent. As a result there was slight oxidation with a considerable drop in the iodine value to 190-195. This would probably not affect the drying properties but the appearance of the oil was impaired. The residual cake contained less than 2% of oil and according to the analysis carried out by the Premier Oil Mills contained 44% of protein and only 6.7% of fibre. The Council has not, up to the present, been informed as to the disposal of either the oil or the cake.

It has been of importance to determine how far the heat treatment of the seeds is effective. The following data is therefore of interest. Nine batches (20 lbs. each) of kernels were sent by Mr. Hartley from Nigeria in 1948. These were examined in September, 1949, and were re-examined after a year's storage in Liverpool as were also (*a*) a sample of 750 lbs. concurrently sent to the Board of Trade and (*b*) samples of heat treated and untreated nuts from Sierra Leone. The results were as follows :—

(20 *lb. batches*)

	1	2	3	4	5	6	7	8	9 (i)	9 (ii)
% F.F.A. in oil (1948) ...	0·3	0·3	0·3	0·7	0·3	0·3	0·3	3·0	2·2	1·7
% F.F.A. in oil (1949) (Sept.)	0·3	0·4	0·7	0·6	0·6	0·4	0·3	2·3	1·9	0·8

The larger delivery of 750 lbs., however, the oil from which had only 0.2% F.F.A. in 1948, showed 7.3, 3.5 and 4.3% F.F.A. (three different extractions) in the oils in September, 1949. It would appear that the heat treatment here had not been completely effective, at all events in some of the kernels.

Of the Sierra Leone nuts the heat treated specimens in September, 1949, gave oil with 0.6% F.F.A. (in September, 1948, 0.2%). The kernels of the untreated nuts (September, 1948, 64.5% F.F.A. in oil) were very rotten and decayed in September, 1949, and the dark oil extracted had 70% F.F.A.

The results as a whole show that, when thoroughly carried out, the heat treatment prevents the development of free fatty acid.

(b) *Groundnuts and Sunflower seeds from Kongwa (Tanganyika).* (Mr. R. Crawford). As is briefly reported in para. 20 oilseeds from groundnuts and sunflowers grown in Kongwa have been analysed. Samples of sun cured and heat treated seeds of three varieties of groundnuts and of sunflower seeds sent to Liverpool in 1948 were stored in the laboratory (*a*) as received and (*b*) with 10% water added. The oils were extracted from the stored samples after six months and after twelve months in store. The seeds as received have kept

well but the moistened seeds developed abundant mould growth and the oils became very highly acid as will be seen from the figures in Tables I and II.

Table I

% FREE FATTY ACID (AS OLEIC) OF THE EXTRACTED OILS

	Oct. 1948	May 1949	
		(as received)	(moistened)
Groundnuts			
Valencia, not heat-treated	0·2	0·9	42·9
,, , heat-treated	0·1	0·9	34·4
Natal Common, not heat-treated	0·1	0·8	28·1
,, ,, , heat-treated	0·1	0·2	36·5
Spanish Bunch, not heat-treated	0·1	0·2	12·4
,, ,, , heat-treated	0·1	0·2	13·9

Table II

% FREE FATTY ACID (AS OLEIC) OF THE EXTRACTED OILS

	Oct. 1948	May 1949	
		(as received)	(moistened)
Sunflower seed			
Not heat-treated	0·8	0·8	21·9
Heat-treated	0·7	1·0	22·1

Samples of the 1949 crop of Kongwa groundnuts were also examined by Messrs. Crawford and Bridges. The oil from the unbroken nuts had a somewhat higher free fatty acid value (0.8% to 1.0%) than the 1948 trial crop (0.1% to 0.2%), but this still compares favourably with the best Indian oils (3% or higher). The oil from the broken kernels was not quite so good (F.F.A. 0.9% to 2.3%). The component acids and glycerides of the groundnut oil from Kongwa have been determined by Mr. R. Crawford and compared with those of West African oils. This work is being prepared for publication.

Mr. Barker examined two samples of the 1949 bulk samples of Kongwa sunflower seeds as received in this country. In one cargo the seeds were from a mixture of two varieties, the Hungarian semi-dwarf striped and the named variety, Mars (Black). The black and striped seeds were carefully segregated and examined separately. The oil yields and qualities were very good. The oils were of a very pale colour and contained only 0.4 to 0.9% free fatty acid ; their iodine values were 125 to 127 and their content of linoleic acid 55-57%. The component fatty acids present in the oils are described in para. (*d*).

(c) *Chemical constitution of drying oils.* (Dr. Seavell and Mr. Barker). Three important papers on the component glycerides of drying oils have now been published in the Journal of the Oil and Colour Chemists Association, 1950, **33**, 6, 24, 49). The main results of these papers may be summarised as follows :—

(i) Criteria can be given for the glyceride structure essential for a serviceable drying oil in either class, and, more important, the glyceride structure is shown to be a function of the proportion of linoleic and/or linolenic acids in the total acids of an oil.

(ii) In the *linoleic-rich* class, the essential condition is that the oil shall not contain more than 10% of mono-linoleo glycerides, i.e. the united content of dilinoleo glycerides and trilinolein should not be less than 90%. This in turn demands that linoleic acid should form not less than 66% of the total fatty acids of the oil.

(iii) In the *linolenic-rich* class, an oil equivalent in properties to linseed oil should contain not less than 60% of dilinoleno glycerides and trilinolenin together, whilst the rest of the glycerides should contain one linolenic group. The oil should also contain not less than 80% di- + tri-polyethenoid (linoleic and/or linolenic) glycerides, about 25% or more of the whole oil containing three polyethenoid groups (linoleodilinolenin and/or trilinolenin). These criteria in turn demand that not less than about 70% of polyethenoid (linoleic and linolenic) acids and not less than 50% of linolenic acid should be present in the total fatty acids of the oil.

(iv) The drying power of an oil can now be referred directly to its content of linoleic or linolenic acid, and no other " drying index " is necessary.

(v) The results of this work have added many useful illustrations of the manner in which vegetable fatty oils are constituted on fundamentally identical principles which have come to be referred to as " even distribution " of the fatty acids amongst the glycerol molecules.

These observations are of interest in relation to the component acids of technical furfural-segrated " extracts " and " raffinates " from soya bean and linseed oils which have been compared with data from Dr. Seavell's low temperature crystallization studies.

(d) *Component acids of Sunflower seeds grown in different localities.* It was mentioned in last year's report, para. 28, that the study of a range of sunflower seeds from many parts of Africa suggested that environment but not biological variety was responsible for the wide variations in the linoleic and oleic acids of sunflower seed oils. An account of this work has now been published in the *Journal of the Society of the Chemical Industry*, 1950, page 16.

No definite information was available as to the specific variety of any of the seeds above-mentioned, although it was apparent that, e.g. black or cream-seeded sorts grown in the same area yielded very similar oils.

Later, the following observations were made which prove that the main factor determining the relative proportions of linoleic and oleic acids in the seed oil is the rate of development of the seed itself. Quick ripening gives oils of low linoleic acid content, and conversly. This has been established as follows :—

(i) *Seeds grown in Africa*

(a) *Named varieties grown in Southern Rhodesia, Kenya and Tanganyika (Kongwa).* Samples were received of the varieties of " Mars " and " Jupiter " seeds grown at three different places. From the same station, oils of identical composition resulted from either variety ; but the same variety yielded oils of definitely different linoleic content when grown in the three different regions.

(b) *Black and cream seeds from Zanzibar.* Here both sorts of seeds were tried at three different places in Zanzibar and Pemba, and very full details as to conditions of soil, climate, etc. were supplied. Either seed gave very similar oil when grown in the same place, but wide differencies in compositions at the three sites. Two of the sites produced oil of the lowest unsaturation (iodine

values 95-113), yet observed in sunflower seed oil. The seeds with lowest unsaturation were from plants which were harvested *two months* after planting; those with the next lowest unsaturation were harvested *three months* after planting, whilst the third site yielded seeds with oil of more normal unsaturation (52-63% linoleic acid) and these required up to *five months* between planting and harvesting.

(ii) *Seeds grown in England.* Samples of the earlier-mentioned seeds from Africa which contained oils ranging from 44% to 72% in linoleic acid content were grown side by side in English gardens in 1949. All the plants yielded seeds with an average content of 70% of linoleic acid in their oils, although individual flower-heads varied from 60% to 75%. It is believed that the heads with lower linoleic contents in their seed-oils were those which faced the light more or less directly, whereas it is known that most of the higher linoleic content oils were from flower-heads which were completely reflexed and faced the ground, thus being shaded. The time of ripening of all the seeds from commencement of flowering was 6 to 8 weeks. These results support the view that rate of development of the seed is the main factor in the character of the seed oil, and further suggest that direct sunlight (apart from temperature) may accelerate the ripening and cause a less unsaturated oil to be produced. It is hoped to make further trials along these lines during the coming season.

(e) *Stillingia oil* (Mr. Crossley). The work on this oil has been continued and is still in progress. The constitution and properties of the short chain decadienoic acid in the oil has been published. The component acids of authentic stillingia oils are given in the following table :—

COMPONENT ACIDS OF AUTHENTIC STILLINGIA OIL (%WT)

	Commercial Oil	Sapium sebiferum			Sapium discolor	
		South Texas	Hong Kong		Hong Kong	
			1947	1949	1947	1949*
IODINE VALUES OF OILS ...	177·6	189·0	190·4	172·7	181·5	177·0
Acid :						
Capric	0·2	0·2	9·2	Trace	0·1	—
Palmitic	7·8	8·7	6·8	8·8	5·6	9·4
Stearic	5·6	3·0	3·4	4·8	3·6	5·8
Arachidic	0·6	0·3	—	—	0·2	—
Decadienoic	4·9	4·2	5·1	5·3	5·3	4·2
Oleic	10·1	7·6	7·0	9·7	8·1	4·2
Linoleic	25·9	25·2	23·5	30·4	35·3	39·7
Linolenic	43·8	50·8	54·0	41·0	40·3	34·1
Elaeostearic	1·1	—	—	—	1·5	2·6

* Approximate figures only : subject to slight revision.

The component acids and glycerides of stillingia tallow have been studied by Dr. M. L. Meara and Mr. S. S. Gupta whilst specimens of *Sapium sebiferum* tallow from Hong Kong and from South Texas and of *S. discolor* tallow from Hong Kong have also been studied.

(f) *Candlenut oils* (Dr. Seavell and Mr. Crossley). Samples of candlenut oils from different sources have now been examined and the oils seem to show

considerable variation as regards the proportion of their major component acids. The results so far obtained are given in the following table :—

COMPONENT FATTY ACIDS OF CANDLENUT OILS (%WT)

	Source of oil						
	Australia 1948	Hong Kong 1947	Fiji 1948	Nigeria 1948	North Queensland 1945	North Queensland 1949	Fiji 1949
IODINE VALUE	163·3	145·3	167·6	165·1	164·3	165·3	163·0
Acids :							
Myristic	0·3	—	—	—	—	0·1	—
Palmitic	9·0	8·6	8·8	7·7	5·5	7·5	8·7
Stearic	4·2	5·2	5·4	5·4	6·7	6·2	3·9
Arachidic	—	—	—	—	0·3	0·1	—
Oleic	14·1	26·7	12·5	14·2	10·5	10·9	15·7
Linoleic	41·6	36·5	38·4	42·0	48·5	46·2	41·5
Linolenic	30·8	23·0	34·9	30·7	28·5	29·0	30·2

(g) *Tobacco seed oil* (Mr. Crawford). The oils from tobacco seeds are of high linoleic acid type but some published records of other samples showed a lower content of linoleic acid (50%). This oil probably resembles sunflower oil in its variability. The figures given in the table below indicate this point and there is little doubt that oils from these sources would find a ready market in the paint industry :—

COMPONENT ACIDS OF TOBACCO SEED OILS (%WT)

	Source of seed				
	Turkey	India (commercial)	Rhodesia Virginia type	Rhodesia Turkish type	English grown
Acids :					
Palmitic	9·0	7·7	7·8	7·6	11·4
Stearic	3·5	3·0	2·8	3·8	
Arachidic ...	0·3	0·9	0·8	0·6	
Oleic	12·0	17·9	12·9	12·9	8·0
Linoleic	74·6	69·4	74·0	74·0	79·1
Linolenic ...	0·6	1·1	1·7	1·1	1·5

(h) *Castor Oil* (Mr. Gupta). The component acids and glycerides of castor oil from various sources referred to in last year's report, para. 43 (g) has now been completed by the analysis of four other oils, and that from East Africa. This oil had 75% of triricinolein, 13% of linoleodiricinoleins and 75% of saturated diricinoleins and minor amounts of oleo- and of dihydroxystearo-diricinoleins.

(i) *Revision of extinction-coefficient reference values used in the spectrophotometric determination of linoleic and linolenic acids* (Mr. C. B. Patel and Dr. J. P. Riley). Since 1943 reliance has been placed on the data then observed by Riley for linoleic and linoleic acids isolated by chemical methods (debromina-

tion of crystalline bromo-adducts), and examined by means of a Hilger spectrograph.

It has for some time been felt very needful to undertake a revision of these values, employing the Beckman spectrophotometer now used for this work, and with linoleic and linolenic acids isolated solely by physical methods.

Linoleic acid has been isolated in a pure condition solely by low-temperature crystallization, accompanied by fractional distillation in a vacuum.

Linoleic acid could not be obtained free from linoleic acid by this means, but utilization of a recently published American adsorption technique using a special silica gel has enabled the pure acid to be successfully isolated.

The results of the revision are as follows :—

Linoleic acid. The old values have been confirmed (to within ± 0.2%). The acid obtained by physical methods gave the same result as that prepared chemically.

Linolenic acid. Here again, the old values were reproduced when chemically-prepared linolenic acid was used; but the linoleic acid isolated (either from conophor or linseed oil acids) by the combined low-temperature techniques gave values for $E^{1\%}_{1cm}$ at 268 mμ. (after alkali-isomerization at 170°/15 minutes) which were about 4% higher than the old values. The new values will have to be substituted in this case for those formerly used.

This implies that the data obtained in earlier work with the old values gives linolenic acid figures which are about 2 units % too high in the case of conophor and linseed oils, the differences being correspondingly less for oils of lower linoleic acid content. These differences are thus, although unfortunate, not very important; but the corresponding alterations in the calculated oleic or saturated data are frequently greater and may amount to ± 4 units % in the fatty acid analyses.

The old and revised data are as follows :—

Acid	After alkali-isomerisation	Mμ	$E^{1\%}_{1cm}$ (old)	$E^{1\%}_{1cm}$ (new)
Linoleic	180° for 60 minutes	234	906	906
Linolenic	170° for 15 minutes	268	532	555
Linolenic	180° for 60 minutes	234	569	575

Plants of Possible Medicinal and Insecticidal Value

39 (a) (44) *Hydrocotyle asiatica* (Uganda). The investigation of the triterpenoids isolated by Dr. Lythgoe and his collaborators working in Professor A. R. Todd's laboratory in Cambridge from the plant, *Hydrocotyle asiatica*, of Indian origin has been continued. It has during this year been extended to a study of plant material from Uganda supplied by Mr. J. W. Purseglove, Agricultural Botanist. Unlike the Indian plant this contains no glycosidic material but sugar-free triterpenoids have been separated and are being examined.

(b) *Alchornea floribunda and Alsodeiopsis staudtii.* (Belgian Congo). It has been stated that the root bark from *Alchornea floribunda* possesses hashish-like activity, whilst *Alsodeiopsis staudtii* is used by the women of certain tribes as an aphrodisiac. Preliminary tests for physiological activity of extracts of this

plant material, prepared by Dr. F. B. Kipping in Professor A. R. Todd's laboratory have been made on rats and dogs. These tests gave negative results but further testing is being carried out. There is at present no evidence that the material as supplied from the Belgian Congo contains anything to account for its reputation.

(c) *Thonningea sanguinea* (Gold Coast). Aqueous extracts of the dried flowers of *Thonningea sanguinea* are used in the Gold Coast as a vermifuge. Arrangements are being made for this material to be pharmacologically tested.

(d) *Euphorbia lancifolia* (Guatemala). The plant *Euphorbia lancifolia* (native name Ixbut) used in Central America is stated to be active in increasing the milk flow in nursing mothers. At the request of the Foreign Office extracts of this are under investigation.

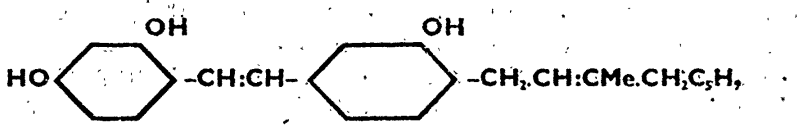
(e) *Picralima nitida* and *Mitragyna* species (Nigeria and Tanganyika). The study of these West African plant materials has been continued in Professor J. W. Cook's laboratory in Glasgow. Dr. J. D. Loudon and Mr. P. McCloskey have extracted the total alkaloids of the seeds of *Picralima nitida* and have confirmed previous work that from this mixture the substance akuammine may be isolated. A small amount of this alkaloid has been prepared in a state of chemical purity and characterised by the preparation of some of its salts. Separation of the other alkaloids has not yet been attempted.

Progress has been made with the correlation of the constituents of plants of the *Mitragyna* genus by Dr. G. M. Badger and Mr. P. A. Ongley. As mentioned in the last report, a triterpene acid present in the bark of *M. inermis* was isolated from both bark and leaves of *M. ciliata* and *M. rubrostipulaceae*, and the sterol extracted from the bark of *M. inermis* has been identified as β-sitrosterol. The separation of rynchophylline and rotundifoline, both present in the leaves of *M. rotundifolia* has been simplified. Although rotundifoline is present in the leaves of *M. ciliata*, the alkaloid extracted from the bark was found to be rynchophylline. Rotundifoline and rynchophylline have both been shown to contain one ethylenic bond in their molecules. Some years ago, Drs. Dyer and Sargent, in collaboration with the late Professor G. Barger, separated a crude amorphus phenolic alkaloid from the leaves of *M. rotundifolia*. From this has now been isolated a new crystalline alkaloid which has been named mitragynol. It is an acidic compound converted by diazomethane into a neutral derivative which is identical with dihydrorotundifoline, formed by catalytic hydrogenation of rotundifoline. From the mixture of bases formed by the selenium dehydrogeneration of rotundifoline Barger and his collaborators isolated a homogenous picrate which has now been identified as the picrate of 3 : 4-diethylpyridine. This suggests a structural relationship to the alkaloid coryhantheine, from which the same base has been obtained by degradation recently carried out by Karrer and Enslin in Zurich. Work on the structural chemistry of the *Mitragyna* alkaloids is now in progress.

(f) *Brachylaena hutchinsii* (Kenya). Dr. J. C. Smith and Mr. G. Pickering have now found that the essential oil from the wood of *Brachylaena hutchinsii* contains two main constituents, a dicyclic sesquiterpene containing two non-conjugated ethylenic linkages and a sesquiterpene alcohol. These are both cadalene derivatives and experiments to determine their structures are now in progress.

(g) *Chlorophora excelsa* (Sierra Leone). By the oxidation of the O-tetramethyl ether of the phenol, chlorophorin, present in the wood of *Chlorophora excelsa*, Mr. M. F. Grundon working under Professor F. E. King in the

University of Nottingham obtained two acids, 2 : 4-dimethoxybenzoic acid and a dicarboxylic acid, $C_{11}H_{12}O_6$. This latter acid has now been shown by synthesis to be 2 : 6-dimethoxy-4-carboxyphenylacetic acid. This, together with other evidence, shows that chlorophorin must be represented by formula (I).



The position of the remaining ethylenic linkage in the residue C_5H_9 has not yet been definitely ascertained, but it is hoped that a study of an acid, $C_{11}H_{18}O_2$ obtained by the oxidation of chlorophorin with hydrogen peroxide in an alkaline solution, may enable this to be determined.

(h) *Dyera costulata* (Malaya). Under Professor E. R. H. Jones work is now in progress in the Manchester University laboratory on the structure of the triterpene alcohol, lupeol, a major constituent of the unsaponifiable material of numerous types of gutta percha.

Previous researches by Ruzicka and others had shown that the majority of the well-defined compounds of the triterpene series could be related to one or other of the three isomeric $C_{30}H_{50}O$ alcohols, α-amyrin, β-amyrin and lupeol, but no connection between these three parent compounds had hitherto been established. It has now been found that isomerisation reactions carried out on both lupeol and β-amyrin derivatives lead to a common intermediate and the structural relationship between these two major groups has thus been elucidated.

(i) *Solanum bifurcum* (Uganda). The leaves of this plant growing in Uganda are being studied by Messrs. Lees and Temple in Professor G. R. Clemo's laboratory. From an aqueous extract a nitrogenous substance has been isolated and is now under investigation.

Striga Hermonthica

40. (45) The investigation of the germination factor has been continued by Professor A. R. Todd and Dr. A. W. Johnson at Cambridge and Dr. R. Brown and Mrs. C. N. Robinson at Leeds. The crude germination factor for *Striga hermonthica* obtained from extracts of the roots of its biological host, sorghum, has been shown to contain various amino-acids and sugars, although no free D-xyloketose has been detected. Application of partition chromatography has revealed that the biological activity is not associated with these classes of compounds, although sugars are probably the precursors of the actual factor. The latter has been concentrated and experiments are now in progress to test the homogeneity of the most active concentrates. Preliminary chemical examination of these is in progress.

A similar series of investigations has been begun on the specific germination factor for *Orobanche* species ; although it is too early to draw definite conclusions, the factor resembles the *Striga* factor in its chemical behaviour.

Gums

41. (46) *Sterculia setigera.* A full account of the analysis of this gum has now been published in a joint paper by Professor E. L. Hirst, Dr. J. K. N. Jones and Mr. L. Hough in the *Journal of the Chemical Society*, 1949, p. 3145.

Pyrethrum

42. (47) By the use of partition between nitromethane and *n*-hexane an excellent method has been devised which enables 85% pyrethrin concentrates to be prepared. By the further use of the Girard reagent the remaining impurities can be removed with the production of a 100% concentrate. This has been used for testing the possibility of developing an infra-red spectroscopic method of assay. In spite of a wide range of chromatographic experiment it has not been found possible to demonstrate the heterogeneity of the pyrethrins using the coloured 2 : 4-dinitrophenylhydrazones.

Colonial Microbiological Research Institute

43. (48) In reporting on the activities of the Colonial Microbiological Research Institute in Trinidad during the year 1949/1950, the Director feels it his duty to point out that certain major and minor defects in the Institute buildings to which he drew attention prior to the opening ceremony in 1948 have interfered with the Institute's activity. One of the most serious of these defects has caused fungus growth to develop and spread in various rooms. Air, contaminated with spores from this mildew growth, is continuously being circulated through the various rooms of the building, and contributes its quota to the difficulties in carrying out pure culture work.

(a) *The disposal of Rum Distillery Lees.* In the report for 1948/1949 a review was given of the work which has been done to solve the problem of rum distillery lees. It was mentioned that further progress could not be made on this investigation until the pilot plant became available, since it was essential to ascertain whether the recommended method of disposal would interfere with the flavour of the rum distilled from re-used waste liquors. As it is now clear that the pilot plant will not be completed for many months to come, this work has been discontinued for the time being.

(b) *The Fermentation of the Cocoa Bean.* Work planned to ascertain the significance of the fermentation process for the processing of the cocoa bean has been actively pursued during the year under review.

(i) *Microbiology of the normal sweating (fermentation) process.* A general picture has now been secured of the types of micro-organisms which are active during the fermentation of cocoa beans, at least in Trinidad and the island of Grenada. It may be claimed that in both countries the micro-organisms which establish themselves initially on and in the pulp of the cocoa bean are almost exclusively yeasts, of which between 30 and 40 strains have been isolated in pure culture. Within 48 hours of the start of the fermentation process the yeast microflora gives way to other micro-organisms, notable to acetic acid producing bacteria. Of these, two types, *Acetobacter rancens* and *Acetobacter melanogenum*, have been found to be predominant. It may be worth recording that, in the fermenting cocoa beans which have been examined no lactic acid bacteria were present. In fermenting beans from Java, examined by Roelofsen and Giesberger (Centrale Vereeniging tot beheer van proefstations voor de overjarige cultures in nederlandsch-indie, Vol. **16**, No. 1, October, 1947), lactic acid bacteria were a predominant type after the first day's fermentation.

The large number of yeasts found present in Trinidad and Grenada during the early period of the fermentation give rise to alcohol and ester production, while the acetic acid bacteria are responsible for the development of acetic acid in the sweating liquor. Though both esters and acetic acid will undoubtedly contribute their share to the eventual flavour of the processed beans, they must be regarded as of secondary importance and have no direct bearing on the presence or absence of a potential chocolate aroma in the fermented beans.

(ii) *The development of the Chocolate Aroma.* Though little experimental evidence is available on how and why the true chocolate aroma develops in fermented cocoa beans it may be claimed that experts agree on the following facts : (*a*) that ripe cocoa beans, which are dried immediately after removal from their pods and then roasted, do not possess any chocolate aroma, (*b*) that cocoa beans, commercially fermented, will yield a typical chocolate aroma on roasting, (*c*) that the intensity of the aroma will increase in fermented and roasted beans on standing.

It was not difficult during the year under review to confirm that ripe cocoa beans, extracted aseptically from their pods and immediately dried and roasted, do not possess any chocolate flavour. Nor was it difficult to prove that the true chocolate flavour in suitably fermented beans is developed only after adequate roasting.

The fact that ripe beans, properly fermented, yield a typical chocolate aroma on roasting has compelled the workers responsible for the research on cocoa fermentation at the Institute to widen their field of investigation and to explore the subsequent chemical changes in the bean on roasting for the development of a chocolate aroma.

Since it was possible to demonstrate that beans, removed aseptically from the pod and kept under conditions of sterility for the length of time and at the temperature prevailing during a normal fermentation process, do develop a slight but characteristic chocolate aroma on roasting, it was obvious that, whatever functions the microflora may exercise on the bean during fermentation, these cannot be essential for the development of a chocolate aroma. In this connection it may be relevant to report also that it has been possible to confirm that the chocolate aroma present in fermented and roasted beans increases in intensity during prolonged storage.

The nature of this precursor should obviously be looked for in fermented beans prior to roasting. Its nature has not so far been ascertained, but a search for it has indicated that polyphenolic fractions extracted from commercially fermented beans are involved since they yield a chocolate aroma on roasting. Similar fractions extracted from non-fermented beans give no aroma on roasting.

(iii) *Polyphenolic substances.* Investigations reported last year on the polyphenolic substances present in fresh and fermented cacao beans have been continued and extended. A note has been published on the application of the technique of paper chromatography to the study of this problem. The polyphenolic substances make up some 30–35% of the dried bean. Although minor changes occur during fermentation in other fractions (proteins, purines, etc.) of the beans it is believed, as has already been signified, that the changes in the polyphenols are of prime importance in determining the taste and aroma of the product. During fermentation the amount of total polyphenols remains practically unchanged, but a large distribution in degree of condensation is apparent. The simpler polyphenols are replaced by highly condensed products.

By introducing new colour reagents, the ability to detect an increased number of phenolic components in a dilute acid extract of a fresh cacao bean has been facilitated. In Forestero beans, in addition to the three anthocyanins, the leucoanthocyanins and the catechins already reported (see communication in Nature (1949), **164**, 25), there are present some 8 to 10 other phenolic substances, as yet unidentified. A survey has been made of many cacao varieties including Venezuelan, Nicaraguan and Central American Criollo ; Ecuador National ; Calabacillo, Trinitario, *Theobroma leiocarpa*, and *Theobroma pentagona*. The anthocyanins present were found to be identical in all the varieties. Indeed

the general picture throughout is very similar, suggesting a close relationship between the varieties. At least six of the additional phenolic substances are common to all. *Theobroma bicolor*, an associated species, shows none of these compounds. Such a diversity in the simple components suggests a great complexity in the more condensed polyphenols and this has been found to be the case. The changes taking place in the simple polyphenols have been followed during "normal" and artificial fermentations. In a normal fermentation only the anthocyanins are completely eliminated during the actual sweat box treatment, the other polyphenols disappear during the drying period. Since it has been possible to show that the cacao aroma is formed during the fermentation even in the case of criollo beans, lacking in anthocyanins, it would appear that it is to the more complex polyphenols that the origin of the cacao aroma must be looked for. This is substantiated by the fact that it is possible to "ferment" beans under aseptic conditions where apparently changes in the simple polyphenols take place, identical to those of a normal fermentation without any production of cacao aroma. For the reasons outlined the attention of the workers studying the fermentation of cacao has turned to the more complex polyphenolic components in an effort to isolate the precursor of the cacao aroma, i.e., the substance present in fermented beans which gives the cacao aroma on roasting. Fermented beans have been fractionated by various techniques and, although the work has not been completed a non-dialysable highly condensed polyphenolic fraction has been separated which on roasting gives a strong cacao aroma. Work is being pursued to obtain the precursor in a homogeneous condition and also to determine the condition of its formation during fermentation.

(c) *The isolation of Antibiotics.* Work on the antibiotic substance obtained from a locally isolated bacterium has been continued with a view to determining the most favourable conditions for its production and also, on the chemical side, to elucidate its chemical structure. Considerable time has had to be spent on discovering means to overcome the apparent tendency of the active organism to lose its power of antibiotic production.

(d) *Panama disease investigations.* During part of the year a research worker from Oxford University has been attached to the Institute for the study of microflora living in the rhizosphere of roots of banana trees, taken from plants resistant to and susceptible to invasion by *Fusarium oxysporum cubense*. The work has revealed that one resistant strain of banana harbours in its rhizosphere certain spore forming and non-spore-forming bacteria which produce antibiotic substances which are highly active against fungi and other micro-organisms. In the rhizosphere of the Panama disease susceptible Gros Michel variety of banana, such bacteria were absent or very rare.

A detailed study of the strains of bacteria isolated from the rhizosphere of the resistant strain of banana is now being carried out for the purpose of determining the nature of the antibotics produced by them.

(e) *Sterol work.* In view of the interest now being taken in the naturally occurring sterols, it was suggested that the Institute should examine various tropical types of micro-organisms for their sterol content and ascertain whether such sterols might differ in nature and quantities from those of micro-organisms living in temperate climates. So far 20 strains of yeast, one strain of an alga and one strain of a spore-bearing rod have been examined.

The most active type of sterol producing organism so far examined is a yeast isolated locally from fermenting cocoa beans. Owing to the delay in the completion of the Institute's pilot plant, the production of sterol from this yeast has had to be restricted to a laboratory scale.

(f) *Hankey Culture Collection.* During the year under review, the first list has been prepared of the organisms maintained in the Hankey Culture Collection. It comprises 284 species, of which 134 have been isolated at the Institute from tropical habitats. The complete list has been forwarded to the Permanent Committee of the Commonwealth Culture Collection in London.

The Collection has sent cultures to various destinations during the year, including Shanghai, South Africa, Jamaica, Mauritius, United States, Mexico, Belgium, Netherlands, India, France and Peru. Of the cultures forwarded to these countries, the bulk have been *Torulopsis utilis* var. *major*, the strain used in food yeast manufacture. Of this organism cultures have been sent to 15 different workers.

(g) *Miscellaneous.* During the year two post-graduate students have spent two months and five months respectively working at the Institute, in one case on a biochemical problem, and in the other on a microbiological problem. In addition one technical assistant, employed by a local brewery has received training in microbiological technique.

During the year the Institute has assisted various local industries and commercial undertakings in the bacteriological control of food substances, and in the estimation of the vitamin content of their products.

A sample of a fungicidal antibiotic produced at the Institute has been sent to the Clove Research Unit at Zanzibar for use in connection with the grafting of roots of clove trees.

The Institute has assisted the Governor of the Windward Islands, in the safe despatch of nutmeg pericarp to the United Kingdom.

At the request of the Council vesicant extracts from the latex of the poisonous tree *Hippomane mancinella* have been collected. Due to an eradication programme in Trinidad the tree is now scarce in this island. However, a tree was eventually found and a crude concentrate of the active principle prepared and despatched.

Other work on Antibiotics

44. Purification of the original strain of Meredith's actinomycete obtained through the courtesy of Dr. A. C. Thaysen, Colonial Microbiological Research Institute, Trinidad, by Professor Hassall and Miss L. Wong working in the University College of the West Indies, resulted in the separation of seven strains, a red, yellow, light yellow, "rough" yellow, "smooth" white, "rough" white and "rough" green which were stable on particular solid media.

In the investigation of the antibacterial activity of the strains on different media, it was found that only the "rough" green produced an antibiotic. No activity was obtained from this "rough" green strain in deep culture. In deep culture the strain was unstable. It gave rise to yellow and red forms. Closer investigations of the optimum condition of growth in flask culture indicated that a medium containing neopeptone and glucose was most favourable for the production of antibiotic. Further experiments on the isolation of the active principle in the filtrate showed that it was relatively stable to heat at pH 7 and 9, but the stability decreased with increasing acidity. It was found that the active principle could be extracted readily by many organic solvents. A procedure involving extraction with ether and purification by separation from the inactive portion that was relatively insoluble in ether and further inactive material insoluble in acetone, was developed. The semi-solid crude concentrate obtained by this method was yellow in colour and readily soluble in petroleum ether. A similar concentrate was obtained by continuous ether extraction of the dried mycelium.

This concentrate which has been given the name of monamycin has high activity against all gram positive bacteria investigated. It has no activity against gram negative organisms.

Comparison of the antibiotics in the literature indicate that the concentrate monamycin resembles most closely the actinomycin group of antibiotics. The limited amount of work which has been done on the properties of monamycin does suggest, however, that it differs from the actinomycin antibiotics already described. Monamycin has a higher solubility in ether than that described on actinomycin and also behaves differently when subjected to chromatography on alumina.

The stability of monamycin and the relatively high antibacterial activity against gram positive organisms suggest that this concentrate is worthy of closer definition. It is an advantage that the strain producing the antibiotic has as yet shown no indication of instability on sub-culturing in solid media. It is possible that this is related to the observations of Whiffen and Savage on the degeneration of activity of *Penicillium notatum* in the production of penicillin. In this work it was shown that when inocula were prepared with rigorous exclusion of spores the penicillin potency remained undiminished even after fifty subcultures. When spores were present the potency was reduced with five to seven subcultures. The " rough " green strain described in this work does not produce spores.

Work on the purification of monamycin and further definition of its biological properties is in progress.

APPENDIX I

List of Publications

Papers Published

The Reaction of Methyl Tetramethyl Glucosaccharate with Sodium. By L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1139.

Deoxy-sugars. Part I. The Dische Reaction for 2-Deoxypentose. By R. E. Deriaz, M. Stacey, Ethel G. Teece and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1222.

Deoxy-sugars. Part II. Synthesis of 2-Deoxy-D-ribose and 3-Deoxy-D-xylose from D-Arabinose. By P. W. Kent, M. Stacey and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1232.

Deoxy-sugars. Part III. Methanesulphonyl Derivatives of D-Arabinose. By W. G. Overend and M. Stacey. *Journal of the Chemical Society*, 1939, 1235.

Deoxy-sugars. Part IV. A Synthesis of 2-Deoxy-D-ribose from D-Erythrose. By W. G. Overend, M. Stacey and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1358.

Deoxy-sugars. Part V. A Re-investigation of the Glycal Method for the Synthesis of 2-Deoxy-D- and L-ribose. By R. E. Deriaz, W. G. Overend, M. Stacey, E. G. Teece and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1879.

Deoxy-sugars, Part VI. The Constitution of β-methyl-2-deoxy-L-ribopyranoside and of αβ-Methyl-2-deoxy-L-ribofuranoside. By R. E. Deriaz, W. G. Overend, M. Stacey and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 2836.

Derivatives of 1 : 6-Anhydro-β-D-idose. By L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1590.

The Conversion of Sucrose into Pyridazine Derivatives. Part VI. The Behaviour of Pyridaz-3-one and its Derivatives towards Aldehydes. By Hilda Gregory, John Hills and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 1248.

The Conversion of Sucrose into Pyridazine Derivatives. Part VII. Some Sulphone Derivatives of 6-Methylpyridazine and 6-Methyl-3-Pyridazone. By Hilda Gregory, W. G. Overend and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 2066.

The Conversion of Sucrose into Pyridazine Derivatives. Part VIII. Some Basic Derivatives of 2-Phenyl-6-Methyl-3-Pyridazone. By Hilda Gregory and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 2546.

The Friedel Crafts Reaction with Itaconic Anhydride. 6-Phenyl-4-Methyl-3-Pyridazone. By S. Dixon, H. Gregory and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 2139.

3 : 6-3 :-Dianhydro-derivatives of β-Methylcellulobioside and of β-Methyl-maltoside. By F. H. Newth, S. D. Nicholas, F. Smith and L. F. Wiggins. *Journal of the Chemical Society*, 1949, 2550.

Interconversion of Dianhydro Hexitols and of Saccharic Acids. By V. G. Bashford and L. F. Wiggins. *Nature*, 1949, *164*, 573.

Conversion of Mannitol and Sorbitol into Dulcitol. By P. Bladon, L. N. Owen, W. G. Overend and L. F. Wiggins. *Nature*, 1949, *164*, 567.

Dianhydrohexitols derived from Mannitol. By L. F. Wiggins. *Nature*, 1949, *164*, 672.

2 : 5-Bishydroxymethylfuran. By L. F. Wiggins. *Research*, 1950, *3*, No. 1.

Preparation of Levulinic Acid. Use of Sodium Levulinate. By L. F. Wiggins. *Research*, 1950, *3*, No. 3.

Utilisation of Cane Sugar. By L. F. Wiggins. *Advances in Carbohydrate Chemistry*, 1949, Vol. IV, 293.

The Sugar Cane as a Source of Raw Materials for Chemical Industry. By L. F. Wiggins. *Chemistry and Industry*, 1949, p. 555.

Anhydrides of Polyhydric Alcohols. Part XIII. The Amino-Derivatives of 1 : 4-3 : 6-Dianhydro-mannitol-sorbitol and L-iditol and their behaviour towards Nitrous-acid. By L. F. Wiggins and V. G. Bashford. *Journal of the Chemical Society*, 1950, 371.

Studies on Trifluoroacetic Acid. Part I. Trifluoroacetic Anhydride as a Promoter of Ester Formation between Hydroxy-compounds and Carboxylic Acids. By E. J. Bourne, M. Stacey, J. C. Tatlow and J. M. Tedder. *Journal of the Chemical Society*, 1949, 2976.

The Diacrylate and Dimethacrylate of But-2-yne-1 : 4-diol. By L. F. Wiggins and D. J. C. Wood. *Journal of the Chemical Society*, 1949, 2371.

Deamination of Certain Amino Derivatives of Sugars and Sugar Alcohols. By V. G. Bashford and L. F. Wiggins. *Nature*, 1950, *165*, 566.

A Modified Method for the End-group Assay of Amylose and other Long-chain Starch Fractions. By E. J. Bourne, K. H. Fantes and S. Peat. *Journal of the Chemical Society*, 1949, 1109–1113.

The Enzymic Synthesis and Degradation of Starch. Part III. The Role of Carbohydrate Activators. By E. J. Bourne, D. A. Sitch and S. Peat. *Journal of the Chemical Society*, 1949, 1448–1457.

The Enzymic Synthesis and Degradation of Starch. Part IV. The Purification and Storage of the Q-enzyme of the Potato. By S. A. Barker, E. J. Bourne and S. Peat. *Journal of the Chemical Society*, 1949, 1705–1711.

The Enzymic Synthesis and Degradation of Starch. Part V. The Action of Q-Enzyme on Starch and its Components. By S. A. Barker, E. J. Bourne and S. Peat. *Journal of the Chemical Society*, 1949, 1712–1717.

The Enzymic Synthesis and Degradation of Starch. Part VI. The Properties of Purified P- and Q-Enzymes. By S. A. Barker, E. J. Bourne, I. A. Wilkinson and S. Peat. *Journal of the Chemical Society*, 1950, 84–92.

The Enzymic Synthesis and Degradation of Starch. Part VII. The Mechanism of Q-Enzyme Action. By S. A. Barker, E. J. Bourne, I. A. Wilkinson and S. Peat. *Journal of the Chemical Society*, 1950, 93.

The Amylolytic Enzymes of Soya Bean. By S. Peat, W. J. Shelan and S. J. Pirt. *Nature*, 1949, *164*, 499.

The Constitution and Properties of a Conjugated Diene Acid present in Stillingia Oil. By A. Crossley and T. P. Hilditch. *Journal of the Chemical Society*, 1949, 3353.

The Seed fat of *Oenothera Biennis* L. By J. P. Riley. *Journal of the Chemical Society*, 1949, 2728–2731.

The Seed fat of *Parinarium laurinum*. By J. P. Riley. *Journal of the Chemical Society*, 1950, 12–18.

The Component Glycerides of Drying Oils. I. Linoleic-rich oils. By B. Barker and T. P. Hilditch. *Journal of the Oil and Colour Chemists' Association*, 1950, *33*, No. 355.

The Component Glycerides of Drying Oils. II. Linolenic-rich oils. By T. P. Hilditch and A. J. Seavell. *Journal of the Oil and Colour Chemists' Association*, 1950, *33*, No. 355.

The Component Glycerides of Drying Oils. III. The Constitution of Solvent-segregated Drying Oils. By T. P. Hilditch and A. J. Seavell. *Journal of the Oil and Colour Chemists' Association*, 1950, *33*, No. 355.

African Drying Oils. II. Component Acids of some Linoleic-rich oils. Niger seed oil. By H. C. Dunn and T. P. Hilditch. *Journal of the Society of the Chemical Industry*, 1950, 13.

African Drying Oils. III. Component Acids of some Linoleic-rich oils. Safflower seed oil. By C. Barker and T. P. Hilditch. *Journal of the Society of the Chemical Industry*, 1950, 15.

African Drying Oils. IV. Component Acids of some Linoleic-rich oils. Sunflower seed oil. *Journal of the Society of the Chemical Industry*, 1950, 16.

Drying Oils with reference to foundry core-bonding agents. By T. P. Hilditch. *British Iron and Steel Research Association*, 1948, 5–7.

Chlorophorin, a Constituent of Iroko, the Timber of *Chlorophora excelsa*. By F. E. King and M. F. Grundon. *Journal of the Chemical Society*, 1949, 3348.

Chlorophorin, a Constituent of Iroko, the Timber of *Chlorophora excelsa*. By M. F. Grundon and F. E. King. *Nature*, 1949, *163*, 564.

Isolation of a Saponin from the Heart-wood of the Mora tree and of a related species, Morabukea. By R. H. Farmer and W. G. Campbell. *Nature*, 1950, *165*, 237.

The Stimulant involved in the Germination of *Striga hermonthica*. By A. R. Todd, R. Brown, A. W. Johnson and E. Robinson. *Proceedings of the Royal Society*, 1949, B.*136*.

Effect of the *Striga* germination stimulation in extensive growth on the roots of peas. By G. R. Brown, E. Robinson and A. W. Johnson. *Nature*, 1949, *163*, 842.

Effects of D-xyloketose and certain root exudates on extension growth. By R. Brown, E. Robinson and A. W. Johnson. *Proceedings of the Royal Society*, 1950, 136B, 577.

The Structure of *Sterculia setigera* Gum. Part I. An Investigation by the Method of Paper Partition Chromatography of the Products of Hydrolysis of the Gum. By E. L. Hirst and J. K. N. Jones. *Journal of the Chemical Society*, 1949, 3145.

Antibiotic Producing Organisms in Tropical Soils. By A. C. Thaysen. *Nature*, 1949, *163*, 835.

The Anerobic Nitrogen fixing Bacteria. By A. C. Thaysen. *Annals de l'Institute Pasteur*, 1949, *77*, 355.

On the Functions of Micro-organisms in the Organic Matric regarded as the Mother Substance of Petroleum. By A. C. Thaysen. *Symposium of the Botanical Society of America*, 27th–30th December, 1949.

A Method for studying the Chemistry of Cacao Fermentation. By W. G. C. Forsyth. *Nature*, 1949, *164*, 25.

Structure of the Triterpenes ; An Inter-relationship between the Lupeol and the β-Amyrin Series. By T. R. Ames and E. R. H. Jones. *Nature*, 1949, *164*, 1090.

The Nitration of some Derivatives of Eugenol. By G. R. Clemo and J. H. Turnbull. *Journal of the Chemical Society*, 1949, 1870.

The Preparation and Resolution of an Externally Compensated Formyl Acid. By G. R. Clemo, W. A. Cummings and R. Raper. *Journal of the Chemical Society*, 1949, 1923.

Papers in the Press

The Terpenes, Volume III. By Sir John Simonsen. Revised Edition. By Sir John Simonsen and D. H. R. Barton. *Cambridge University Press.*

Condensation of the Pyridazones derived from Levulinic Acid with Formaldehyde and Benzaldehyde. By L. F. Wiggins.

The Configuration of naturally occurring mixed Glycerides. Part VI. The Component Fatty Acids and Glycerides of Stillingia Tallows. By S. S. Gupta and M. L. Meara. *Journal of the Chemical Society.*

African Drying Oils. V. Some Nigerian and Sudanese drying Oils. By C. Barker, H. C. Dunn and T. P. Hilditch. *Journal of the Society of the Chemical Industry.*

The Influence of Environment upon the composition of Sunflower Seed Oils. Part I. Individual Varieties of Sunflowers grown in different parts of Africa. By C. Barker and T. P. Hilditch. *Journal of Scientific Food Agriculture.*

Composition of the Seed Oils of Sunflowers grown in English gardens from five specimens of different African Sunflower Seeds. By C. Barker and T. P. Hilditch. *Journal of Scientific Food Agriculture.*

Yeast Growth and Protein Synthesis. By A. C. Thaysen. *Economic Botanist.*

Food Yeast in the British Empire. By A. C. Thaysen. Paper to be presented before the Committee of the United Nations Scientific Conference on the Conservation and Utilisation of Resources.

Alkyl Naphthalenes. Part III. By J. C. Smith. *Journal of the Institute of Petroleum.*

APPENDIX II

List of Patents

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 the 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 alcohols. 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.

Improvements relating to synthetic resins and articles made therefrom. L. Osborne and L. F. Wiggins. No. 19408/1948.

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

Colonial
Social Science Research Council
Sixth Annual Report
(1949-1950)

London School of Economics and Political Science,
Houghton Street,
W.C.1.

16th May, 1950.

SIR,

I have the honour, on behalf of the Colonial Social Science Research Council, to transmit to you the sixth report of the Council, covering the period from 1st April, 1949, to 31st March, 1950.

I have the honour to be,
Sir,
Your most obedient servant,
(sgd.) A. M. CARR-SAUNDERS.

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

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

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

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

DR. AUDREY RICHARDS, M.A., Ph.D. (Until November 30th, 1949) Reader in Social Anthropology, University of London.

PROFESSOR R. H. TAWNEY, B.A., Litt.D., D. ès L. Paris, F.B.A., Professor of Economic History, University of London.

PROFESSOR SIR GODFREY THOMSON, D.C.L., D.Sc., Ph.D., Professor of Education, University of Edinburgh.

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

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

SIXTH ANNUAL REPORT

I. INTRODUCTORY

The Council held four meetings during the year 1st April, 1949–31st March, 1950. Ten meetings of Standing Committees of the Council took place.

2. The re-organisation of the Council's work referred to in last year's report was effected during the summer of 1949. Standing Committees on Anthropology and Sociology, on History and Administration, on Law (including Land Tenure), on Linguistics and on the Selection and Training of Personnel have been set up and through them, it has been possible to associate a number of eminent specialists with the activities of the Council. Further details of the working of the Committees are given later in this report.

3. The membership of the Council was expanded to include Professor R. H. Tawney, Professor of Economic History at the University of London, Professor Vincent Harlow, Beit Professor of Imperial History at the University of Oxford, Professor E. E. Evans-Pritchard, Professor of Social Anthropology at the University of Oxford and Fellow of All Souls' College, and Mr. C. G. Eastwood, Assistant Under-Secretary of State, Colonial Office.

Dr. Audrey Richards, Reader in Social Anthropology at the University of London, resigned from the Council at the end of 1949 in order to take up her appointment as Director of the East African Institute of Social Research at Makerere. Dr. Richards had been associated with the work of the Council since 1944.

4. Professor Frank Debenham and Dr. Audrey Richards attended the African Regional Scientific Conference as delegates of the United Kingdom.

II. GENERAL

5. During the year under review the Council has been occupied with the special problems that arise in the organisation of research when all possible economy has to be exercised in the expenditure of the funds available. With this end in view, it has paid particular attention to the staffing of Regional Institutes approved in principle in earlier years and to their relationship with Colonial universities, to the further employment of sociologists and other workers who have become accustomed to Colonial conditions after a period of field research (rather than the employment of untried candidates) and to the fullest possible utilisation of the experience of research workers by allowing adequate time for writing up the product of research and for study leave and discussion with other workers in the same field.

6. Progress has been made in the establishment of the Institute of Social and Economic Research attached to the University College of the West Indies. This Institute, under the direction of Dr. Dudley Huggins, now has the services of three research workers who, with the Director, are preparing their long-term research programme. The East African Institute of Social Research, whose programme is discussed in detail below, has been fortunate in obtaining the services of Dr. Audrey Richards as Director. Staff for the Institute is now being recruited. An administrative Secretary has been appointed to the Institute of Social and Economic Research at Ibadan and it is hoped to recruit a Director shortly.

7. The recruitment of research staff, which in earlier years proved the most

formidable barrier to the carrying out of research in the social sciences, showed some signs of improvement at the junior levels. The scheme initiated last year provided for the award of 12 post-graduate studentships tenable at Universities in the United Kingdom for training in the social sciences prior to a research appointment of not less than two years in the Colonies, has been slightly expanded by the addition of four more studentships. Fifteen of these studentships have been awarded and over half of the students have completed their training and are now in the field. One unfortunately had to be invalided home at an early stage in his field work and another was unable to complete training for personal reasons outside her control. The projects on which the trained post-graduate students are engaged are described in Section III. Of those still under training one will make a study of the family structure of the Kikuyu of Kenya, one will study a Bantu tribe in East Africa, one a nomadic people of North-Eastern Kenya, and the last a people of the Northern territories of the Gold Coast.

8. The scheme initiated last year for the employment of a small number of American social scientists on research projects in the Colonies after some preliminary training in the United Kingdom has proceeded. One American sociologist is already at work in Nigeria. Three others will have completed training before the end of the summer and a fifth will be arriving shortly to start training. The American sociologists who are not yet in the field will work in Kenya, Uganda and, probably, Nigeria.

9. Last year saw some advances in the promotion of social science research concerned with the solution of pressing administrative problems by Government. In Tanganyika, for example, a department consisting of three government anthropologists has been set up and is engaged on investigations of the tribes of the Northern Provinces and Sukumaland with a view to the introduction of important local government reforms. In Sierra Leone, in view of the need for a forward soil conservation policy, a government survey of land utilisation has now been undertaken. The interesting work carried on by the Singapore Department of Social Welfare was made known to the public last year through the publication of the results of a social survey of Singapore carried out by members of its staff. The Gold Coast Government will shortly publish Dr. K. A. Busia's urban survey of Sekondi-Takoradi.

10. The new Colonial Universities are beginning to be in a position to sponsor research in the social sciences. Pending the full operation of the Institute of Social and Economic Research at Ibadan the University College has been sponsoring a preliminary urban survey by a geographer with anthropological training and a study of Native Administration finance. Interesting material in the field of educational psychology is being collected at Makerere College. At the University College of the Gold Coast, a new Department of African Studies will, it is hoped, include sociological research in its programme. At Hong Kong University, land utilisation surveys of type areas and other geographical studies have been undertaken. In Malaya, the Professor of Economics at the University took a leading part in the Singapore Social Survey mentioned above, and the University is now strengthening its Department of Economics with a view to further investigations in the field of social science.

11. This report would not be complete without some reference to the work undertaken without assistance from Colonial Development and Welfare funds by institutions of higher learning in the United Kingdom. Among these may be mentioned the Institute of Social Anthropology at Oxford University, which is supervising a number of anthropological projects in the colonies apart from those financed from Colonial Development and Welfare funds; the Faculty

of Archaeology and Anthropology at the University of Cambridge, which is sponsoring research in, for example, legal sociology in the Gold Coast and social anthropology in the West Indies ; the School of Oriental and African Studies of the University of London, which is sponsoring studies of Nigerian land, law and custom, and Moslem procedure, linguistic research in Somali, Hausa, Fulani, various Central African languages and Oceanic linguistics, and studies of tribal history in tropical Africa ; the Colonial Research Division of the London School of Economics which is carrying out preparatory work for a British colonial atlas ; and finally the Committees for Colonial Studies and Advanced Studies at Oxford University, and Nuffield College, who are between them sponsoring a wide range of research in Colonial History, Law and Administration.

The Institutes

West Indies

12. The major activities of the Institute were financed under a scheme approved in April, 1949, and it was on the basis of this financial authority that three research assistants, two secretarial assistants, a library and technical assistant were appointed. Up to the present the Institute has been mainly concerned with organisation and building up its records. A research programme is being planned and will almost certainly include studies in labour productivity, juvenile delinquency, and the effects of seasonal variations on local economic activities. Sir Arnold Plant, a member of the Colonial Social Science Research Council, and the Chairman of the Colonial Economic Research Committee, visited Jamaica in early February for consultations on the Institute's programme and also to take part in the ceremonies for the installation of the Chancellor of the University College of the West Indies.

13. *East Africa.* The new Director's programme for the Institute can be summarized as follows :—

(*a*) The establishment of a centre of African and mainly East African Studies, including knowledge of the cultures and languages of the East African peoples and their legal systems, political structures and economic organisation ;

(*b*) the organisation of comparative studies of particular problems ;

(*c*) the organisation of experiments in research methods ;

(*d*) the organisation of studies of administrative importance on behalf of the Government, and

(*e*) the training and supervision of field workers in the region, both European and African.

In the next five years the Institute will concentrate on linguistic studies, basic ethnographic studies recommended in reports on social research needs prepared for the Council by Professor Schapera and Dr. Stanner, the utilisation of these basic studies in a comparative study of local government, and finally, an urban survey of Jinja and its periphery.

It is hoped that the Institute will provide not only its own team of workers continuously engaged in East African social studies but also a centre for discussion and assistance for independent research workers.

Building on a modest scale should start shortly. It is hoped to provide field workers and visiting social science workers with living accommodation, basic clerical and secretarial facilities, and the loan of stores of field equipment.

14. *West Africa.* A Colonial Development and Welfare research grant has been made to the University College at Ibadan to cover buildings for the Institute and housing for the staff, and the appointment of a Director and Administrative Secretary. An Administrative Secretary, Mr. D. N. Leich of the Nigerian Service, has already been appointed and it is hoped to appoint a Director very shortly. No programme has as yet been worked out for the Institute, but it is expected that it will take a leading part in the organisation of social and geographical surveys.

15. *Rhodes-Livingstone Institute.* A grant of £100,000 spread over five years has been made from Colonial Development and Welfare funds to the Board of Trustees of the Rhodes-Livingstone Institute, who have secured further contributions from Central African Governments and private interests.

The Institute's programme is based on a seven-year research plan prepared by Professor Gluckman, former Director of the Institute. The new Colonial Development and Welfare grant will enable this programme to be more fully put into effect. It is proposed to appoint a demographer who, with a team of African assistants, will carry out sample censuses in both urban and rural areas which will give information on the general population trends.

It is hoped that two urban sociologists with a team of African assistants will investigate the process of urbanization of African peasants and provide a complement to work undertaken by the Institute's anthropologists in the rural areas of Northern Rhodesia and Nyasaland.

III. PROJECTS IN PROGRESS (1)

Africa

Ethnographic Survey of Africa

16. The Ethnographic Survey of Africa, which has been in operation for five years under the general direction of Professor Daryll Forde, has now reached a stage where a number of surveys are in the course of publication under the auspices of the International African Institute. Extensive material has been collected in East Africa by Dr. and Mrs. Meinhard. The survey has been extended for a further three years, the funds made available to the International African Institute being administered with the help of a Committee of anthropologists under the chairmanship of Professor A. R. Radcliffe-Brown.

17. *Handbook of African Languages.* The preparation of this handbook is making steady progress.

Sections on the peoples of Lake Nyasa, the Akan and Ga-Adangme people of the Gold Coast, the Ibo and Ibibio of Nigeria and the peoples of Sierra Leone are complete and in the press. Sections on the Yoruba and the Bemba and Lala peoples are nearing completion.

18. *Study of French Administration in North Africa.* Miss S. Eyre Crowe is now writing up the results of her investigations under the supervision of the Colonial Studies Committee of Oxford University.

19. *Survey of the North Bantu Linguistic Border.* A research scheme organised by the International African Institute to make a field study of the North Central area of Africa where the Sudanic languages come into contact with the Bantu languages is now in operation. Its four members (one Belgian, one French and two British) are in the field. The project is jointly financed from

(1) Projects started in the year 1st April, 1949—31st March, 1950 are marked with an asterisk.

the Colonial Development and Welfare Research allocation and by the governments of France and Belgium. It is being supervised by Dr. A. N. Tucker and Dr. Malcolm Guthrie of the School of Oriental and African Studies.

20. *African Marriage Survey.* This study continues under the direction of an executive committee under Sir John Waddington. Mr. Arthur Phillips, of the London School of Economics, has been continuing his work on the legal and administrative side, and a research assistant is continuing the study of anthropological material.

21. *Socio-Economic Survey of Zaria, Nigeria.** Mr. M. G. Smith, who was trained under the post-graduate studentship scheme, is now at work on a social survey of Hausa communities. Mr. Smith is assisted by his wife, who is concentrating on the domestic aspects of the inquiry. Up to the present, field inquiries at Giwa and Fatika are complete. The project is under Professor Daryll Forde's supervision.

22. *Socio-Economic Survey of Mba-Ise, Owerri, Nigeria.** Mr. E. W. Ardener, who was trained under the post-graduate studentship scheme, is now engaged in a study of the social structures of a section of the Ibo people in Owerri Province, Nigeria, where they are under economic stress apparently because of population and soil exhaustion. The project is under Professor Raymond Firth's supervision.

23. *Psychological Testing in Nigeria.** Dr. Geoffrey Tooth has carried out, on the invitation of the Nigerian Government, researches into the test material suitable for Africans seeking technical and professional training. A report is being prepared. The project is under Professor Sir Godfrey Thomson's supervision.

24. *Socio-Economic Survey of Oshogbo, Nigeria.** A socio-economic survey of Oshogbo, an African town in S.W. Nigeria, is being undertaken by Mr. W. B. Schwab, the first American sociologist selected under the scheme referred to in paragraph 8 to finish his preliminary training. The project is under Professor Daryll Forde's supervision.

25. *Historical Research, Nigeria.** The Council was particularly glad to recommend the award of a grant to Mr. K. O. Diké, a Nigerian graduate of Aberdeen University, to continue his collection of material from official and private sources on Delta trade and politics in the middle of the last century. Much of his material is being drawn from family records and traditions which are in danger of being lost unless they are soon garnered.

26. *Legal Research, Nigeria.** Dr. J. Schacht, Reader in Islamic Law at Oxford University, has visited Northern Nigeria to study the application and modification of Islamic law in recent years. A report will be submitted. The project is supervised by the Colonial Studies Committee of Oxford University.

27. *Economic position of women in the Cameroons.* The report prepared by Dr. Phyllis Kaberry on this subject is now nearly ready for publication.

28. *Secondary School Science Teaching in Nigeria.* Mr. F. W. Smithies' report on this subject has been received and is being distributed to African educational departments for information.

29. *Linguistic Research, Gold Coast.* It is hoped that the material collected by Mr. J. Berry during the field work in the Gold Coast, where he investigated Adangme language problems, will shortly be ready for publication.

30. *Socio-Economic Study of the Krobo people, Gold Coast.* Mr. K. T. S.

Baldwin, a member of the staff of the University College of the Gold Coast, has now completed his fieldwork and is writing a study of the Krobo under academic supervision at the University of Oxford.

31. *Historical Research : Gold Coast.* Miss Freda Wolfson, now on the staff of the School of Oriental and African Studies, was given leave of absence for a further six months this year to continue her investigations. She has been examining records and collecting traditions in the Gold Coast as material for a study of British relations with the Gold Coast during the 19th century.

32. *Socio-economic survey of rural communities of the Colony peninsula, Sierra Leone.* Miss E. M. Richardson and Mr. G. C. Collins, both of whom were trained under the post-graduate studentship scheme, are carrying out a survey of the rural areas of the Colony. Mr. Collins has been trained as a geographer, Miss Richardson as a sociologist. The project is being supervised by Dr. E. Leach, Dr. K. Little, Mr. Robert Steel and Mr. W. H. Beckett.

33. *Anthropological Research on the Mende, Sierra Leone.* Dr. Sjoerd Hofstra, Director of the Prins Hendrik Museum in Rotterdam, was able to spend a month in London during the summer of 1949, working on linguistic aspects of the field material he collected in Sierra Leone, with help from the School of Oriental and African Studies.

34. *Political Organization of Typical Communities in the Gambia, and Sociological Research at Genieri, Gambia.** Dr. D. P. Gamble, a Colonial Research Fellow, prepared on his return from the Gambia, a detailed interim report covering various aspects of social and economic organization of three communities—a Mandinka, a Wolof and a Jola—which is now being studied by the Council. Dr. Gamble has now returned to the Gambia, with assistance from both Colonial Development and Welfare and Gambia Government funds, to make an independent appraisal of the impact of the work of the Nutrition Field Working Party on neighbouring village communities. The project is under Professor Daryll Forde's supervision.

35. *Linguistic Research in Somaliland Protectorate.** A grant from Colonial Development and Welfare funds has been given to Mr. B. Andrzejewski, a former student of the School of Oriental and African Studies and holder of a Linguistic studentship, for research into the Somali language and its dialectal forms. Mr. Andrzejewski is being attached for the purpose to the Somaliland Department of Education. The project is under the supervision of Professor J. R. Firth.

36. *Anthropological study of the Kisii, Kenya.* Dr. Philip Mayer, assisted by his wife, is now at work writing up the material collected during his investigation of the Kisii (Gusii) people of Kenya. Papers by Dr. Mayer on Kisii lineage and Kisii bridewealth, based on this material, have been published by the International African Institute and the Rhodes-Livingstone Institute respectively. The project is under Professor E. E. Evans-Pritchard's supervision.

37. *Anthropological study of the Turkana, Kenya.** Mr. Philip Gulliver, who was trained under the post-graduate training scheme referred to in paragraph 7 has completed the first phase of his field work among the Turkana, and is writing an interim report under the supervision of Professor I. Schapera of the University of Cape Town. Mr. Gulliver will shortly make a short study of the Jie people of Uganda, to whom the Turkana are related, with a view to pursuing the study of certain puzzling features of Turkana social organization.

38. *Anthropological study of the Acholi, Uganda.** Mr. Frank Girling, also trained under the post-graduate training scheme, is making a study of the

Acholi people, one of those which require early study for scientific and administrative reasons. The project is under Professor E. E. Evans-Pritchard's supervision.

39. *Anthropological study of the Lugbara, Uganda.** The Council recommended that a Goldsmith travelling scholarship awarded to Mr. J. F. M. Middleton should be augmented by a grant from Colonial Development and Welfare funds, so that he could make a thorough study of the Lugbara, a people concerning whom little information exists and who present problems both to scientists and to administrators. Mr. Middleton is now in the field. He is being supervised by Professor E. E. Evans-Pritchard.

40. *Anthropological study of the Alur and Jonam, Uganda.** Mr. Aidan Southall, who has previously undertaken research into the Luo people with assistance from Colonial Development and Welfare funds, has been awarded a Colonial Research Fellowship for work among the Alur and Jonam, about whom no adequate information exists.

41. *Research into East African Music.* Dr. Klaus Wachsmann's researches, assisted for a period with a grant from Colonial Development and Welfare funds, have resulted in the publication of articles in learned journals. Other papers on the same subject will, it is expected, be published by Dr. Wachsmann.

42. *Anthropological study of the Amba and Konjo, Uganda.** Mr. E. H. Winter, an American sociologist selected under the scheme referred to in para. 8 is about to start a study of two little-known peoples, the Amba and Konjo, who live on the borders of Uganda and the Belgian Congo. Mr. Winter will work under the supervision of Dr. Audrey Richards.

43. *Legal studies in Northern Rhodesia.** Mr. Arnold Epstein is making a preliminary study of customary law in the urban areas of Northern Rhodesia. He is working under the supervision of Mr. Arthur Phillips.

44. *Translation of Paulitschke's "Ethnographie Nord-Ost Afrikas".* The translation by Miss Edith Cory is nearly complete.

45. *Social Survey of Zanzibar.* The analysis of the material collected by the survey team under the direction of Professor Edmund Batson, Dean of the Faculty of Social Sciences in the University of Cape Town, is well advanced. The United Nations Economic and Social Council has been provided, at its request, with methodological notes on the techniques employed.

46. *Study of Administration by Native Authorities in Nyasaland.* Dr. Lucy Mair has made a study of the effectiveness of native institutions as an agency of modern government in a recent trip to Nyasaland. She was also able to visit Swaziland for comparative purposes. A report is being prepared.

47. *Native Land Tenure in Basutoland.* Mr. Vernon Sheddick is just about to complete his fieldwork and will be writing up his material under academic supervision in Cape Town.

B. Far East

48. *Anthropological studies in Sarawak.* During the year under review four anthropological research projects undertaken in Sarawak as a result of Dr. Leach's recommendations were progressing successfully. Dr. Ju-Kang T'ien has now returned to the United Kingdom and is writing up the results of his study of the Chinese community. Mr. H. S. Morris is studying a Melano community primarily engaged in the production of sago by primitive methods. Mr. W. R. Geddes is studying a Land Dyak community in contact with alien

cultures. Mr. J. D. Freeman, who is studying a traditional Iban community, has collected and transcribed a great deal of material, including much on the ritual and technical practices of rice farming. He is assisted by his wife who, besides collecting anthropometric data, has studied domestic crafts.

The fourfold project is supervised by Dr. Edmund Leach.

49. *Sociological studies in North Borneo.** Miss Monica Glyn-Jones, a geographer, who has been trained under the post-graduate studentship scheme, is now undertaking a socio-economic survey of a settled Dusun community in North Borneo, with particular reference to the environmental factors affecting rice production. Her work is being supervised by Dr. Edmund Leach.

50. *Sociological studies in Singapore.** The studies started in Singapore at the end of last year by Mr. Maurice Freedman and Miss Judith Djamour (Mrs. Freedman) on Chinese family structure and Malay family structure respectively are progressing successfully. Mr. and Mrs. Freedman are attached to the Singapore Department of Social Welfare. Mr. Alan Elliott, who was awarded a Colonial social science research studentship, completed his period of training and has now arrived in Singapore to study some aspects of the relations of the Singapore Chinese with China itself. These three studies are under Professor Raymond Firth's supervision.

C. Pacific

51. *Educational Research, Fiji.* A grant of approximately £21,000 has been made from the Colonial Development and Welfare Research Allocation towards the setting up of an Educational Research Institute at Nasinu Training College. A sum of about £9,000 has been provided by the Fiji Government.

52. *Linguistic Research in Fiji, Tonga and the Solomon Islands.* Mr. F. Milner's researches are making steady progress and have been undertaken with the personal assistance of the Secretary for Fijian Affairs, Ratu Sir Lala Sukuna, and his administrative officials in rural districts.

D. West Indies

53. *Psychological testing in the West Indies.* Mr. A. Deans Peggs is continuing his investigations of the mental ability of the West Indian child in Jamaica. He will complete his field work in the late summer of 1950.

Mr. B. J. Bedell, who has been pursuing similar investigations in Trinidad, has completed his field work and has been writing his report.

Both Mr. Deans Peggs and Mr. Bedell are working under Professor Sir Godfrey Thomson's supervision.

54. *Social Survey of Jamaica.* The team which has been carrying out this survey in earlier years under the direction of Miss Edith Clarke has now returned to the United Kingdom where its reports are being written under the supervision of a committee appointed by the London School of Economics.

55. *Study of Friendly Societies.* Mr. A. F. Wells has completed his report on the Friendly Societies of the West Indies and it is now being considered by the Governments concerned.

IV. ORGANISATION

56. Mention has already been made in para. 2 of the reorganisation which has resulted in the setting up of five specialist committees of the Council.

57. The Standing Committee on Anthropology and Sociology, perhaps the

most active of all the Standing Committees, is under the chairmanship of Professor Sir Godfrey Thomson, a member of the Council, and includes in its membership Professor E. E. Evans-Pritchard, Professor Raymond Firth, and Professor Margaret Read, all members of the Council, and Professor Daryll Forde, Professor of Anthropology in the University of London, Professor J. H. Hutton, William Wyse Professor of Social Anthropology at the University of Cambridge, Mr. K. E. Robinson, Reader in Colonial Administration at the University of Oxford, and Mr. R. S. Hudson, Head of the African Studies Branch of the Colonial Office.

58. The Standing Committee on History and Administration is under the Chairmanship of Professor Vincent Harlow, a member of the Council, and its members include Mr. H. V. Hodson and Miss Margery Perham, members of the Council, Mr. K. E. Robinson, Mr. Douglas Veale, the Registrar of the University of Oxford, Dr. S. F. Nadel, Professor of Social Anthropology at the University of Durham, Professor Gerald Graham, Rhodes Professor of Imperial History at the University of London, and Mr. F. J. Pedler of the United Africa Company, and at one time a member of the Colonial Office.

59. The Standing Committee on Law and Land Tenure is under the chairmanship of Professor Frank Debenham, a member of the Council, and its membership consists of Dr. C. K. Meek, University Lecturer in Anthropology at the University of Oxford and Fellow of Brasenose College, Dr. Meyer Fortes, Reader in Social Anthropology at the University of Oxford and Professor-elect of Social Anthropology at the University of Cambridge, Mr. Arthur Phillips, lecturer in Law at the University of London, Professor S. G. Vesey-Fitzgerald, Professor of Oriental Law at the University of London, and Professor M. Postan, Professor of Economic History at the University of Cambridge.

60. The Linguistics Committee is under the chairmanship of Professor Sir Ralph Turner, Director of the School of Oriental and African Studies of the University of London, a member of the Council, and includes Professor J. R. Firth, Professor of General Linguistics at the University of London, Dr. M. Guthrie, Reader in Bantu Languages in the University of London, and Dr. Edwin Smith, late Director of the International African Institute. The late Professor Ida Ward, who was until her death Professor of West African Languages at the University of London, was invited to join the Committee. Her death was a grievous blow to linguistic research in Africa and has left an irremediable gap in the ranks of linguistic scholarship.

61. The Committee on the Training and Selection of Personnel is under the Chairmanship of Mr. H. V. Hodson, a member of the Council, and includes Mr. R. S. Hudson, Head of the African Studies Branch in the Colonial Office, Mr. J. G. Hibbert, Head of the Research Department in the Colonial Office, and members of the Council and Standing Committees, who are co-opted for particular meetings in which they are concerned.

V. PUBLICATIONS

62. The following works of major importance were published this year with assistance from Colonial Development and Welfare funds.

R. R. Kuczynski : A Demographic Survey of the British Colonial Empire (Volume II, East Africa).
(Royal Institute of International Affairs and Oxford University Press).

Doreen Ingrams : A Survey of Social and Economic Conditions in the Aden Protectorate (Government of Aden).

The following studies were in course of publication :—

Dr. Geoffrey Tooth : Studies in Mental Illness in the Gold Coast (His Majesty's Stationery Office).

Sections of the Ethnographic Survey of Africa (International African Institute and Oxford University Press).

Publication of the following studies were under consideration :—

Dr. E. R. Leach : Social Research in Sarawak.

Dr. Philip Mayer : Studies in Gusii Social and Economic Organization.

Dr. W. E. H. Stanner : Social Research in Uganda and Tanganyika.

B. J. Bedell : Report on Mental Aptitude testing of Trinidad School-children.

A. F. Wells : Friendly Societies in the West Indies.

A number of papers embodying the results of fieldwork undertaken with assistance from Colonial Development and Welfare funds and under the auspices of the Colonial Social Science Research Council have appeared in scientific journals published in the United Kingdom, Commonwealth and abroad.

Colonial Medical Research Committee Fifth Annual Report (1949-1950)

Medical Research Council,
38, Old Queen Street,
S.W.1.

22nd July, 1950.

Sir,

On behalf of the Colonial Medical Research Committee, I have the honour to transmit to you the Fifth Annual Report of the Committee, covering the period 1st April, 1949, to 31st March, 1950.

I have the honour to be,
Sir,
Your obedient Servant,
H. P. HIMSWORTH
(Chairman)

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

COLONIAL MEDICAL RESEARCH COMMITTEE

Membership

DR. H. P. HIMSWORTH, M.D., F.R.C.P., Secretary, Medical Research Council (*Chairman*).

BRIGADIER J. S. K. BOYD, O.B.E., M.D., Ch.B., D.P.H., D.T.M. & H. (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.

SIR ALAN DRURY, C.B.E., M.D., F.R.S., Director, Lister Institute of Preventive Medicine.

SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S., Wellcome Professor of Tropical Medicine, University of London.

DR. F. HAWKING, D.M., D.T.M., National Institute for Medical Research.

PROFESSOR B. G. MAEGRAITH, M.B., B.S., D.Phil., M.R.C.P., Professor of Tropical Medicine and Dean of Liverpool School of Tropical Medicine.

PROFESSOR B. S. PLATT, C.M.G., M.Sc., Ph.D., M.B., Ch.B., Professor of Nutrition, University of London.

DR. E. D. PRIDIE, C.M.G., D.S.O., O.B.E., M.B., B.S., Chief Medical Officer to the Secretary of State for the Colonies.

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.

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.

COLONIAL MEDICAL RESEARCH COMMITTEE

FIFTH ANNUAL REPORT

CONTENTS

COLONIAL MEDICAL RESEARCH COMMITTEE

FIFTH ANNUAL REPORT

GENERAL

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

2. It was with great regret that in August the Committee received the resignation of its Chairman, Sir Edward Mellanby, G.B.E., K.C.B., F.R.C.P., F.R.S., in consequence of his retirement from the appointment of Secretary of the Medical Research Council of Great Britain. Sir Edward had guided the activities of the Committee since its inception. His personal distinction and wealth of experience in the field of medical research did much to secure the vigorous development of medical research in Colonial Territories.

The Committee has been fortunate to secure as its new Chairman, Dr. H. P. Himsworth, M.D., F.R.C.P., the new Secretary of the Medical Research Council, a medical research worker of international repute.

3. Dr. E. D. Pridie was appointed a member of the Committee on assuming the post of Chief Medical Officer at the Colonial Office. Sir Neil Hamilton Fairley, whose place had been taken temporarily by Professor G. Macdonald, rejoined the Committee in April, 1949, and resumed the Chairmanship of the Malaria and Helminthiasis Sub-Committees. Dr. R. Lewthwaite took over the joint Secretaryship from Dr. A. F. Mahaffy from April 1st, 1949.

COLONIAL RESEARCH SERVICE

4. During the year the Colonial Office brought into being a scheme for the formation of a Colonial Research Service designed to include research workers in all subjects. The Colonial Medical Research Committee have submitted to the Secretary of State a memorandum making suggestions for alterations in the administration and design of this Research Service, in so far as it effects workers in medical research, which they consider would improve the service and make it more attractive. Their memorandum is under consideration by the Secretary of State.

WORK OF THE COMMITTEE

General

5. All the main research schemes initiated or supported by the Committee, which were in progress during 1948-49, have been continued. As certain additional staff has become available it has been possible to expand some of the research teams and to initiate one or two new projects, but the general shortage of trained workers still limits the development of important lines of work. The Committee has recognised the need to bring new workers into the field of tropical medical research and for the purpose has recommended grants of Colonial Research Studentships to four medical graduates during the year on improved terms. One Student is studying the techniques of virus investigation under Professor F. M. Burnett, F.R.S., at the Walter and Eliza Hall Institute of Medical Research, Melbourne; two others are pursuing general entomological studies at the London School of Hygiene and Tropical Medicine in the Department of Professor P. A. Buxton, F.R.S.; a fourth is engaged on the study of helminthology at the National Institute for Medical Research, under Dr. F. Hawking, M.D.; a fifth will shortly complete his two-year tenure of a Studentship and thereafter join the staff of an overseas research project.

Development of New Research Schemes.

6. New research schemes initiated during the year, and developments in existing schemes, are summarized below.

(*a*) *Leprosy*

Dr. F. S. Airey, M.R.C.P., an experienced dermatologist, has been appointed to study this disease, in relation especially to the excellent therapeutic results, recently reported from various quarters, given by the sulphone group of drugs. After a brief study of special techniques in laboratories at Oxford and London, he has been posted to Malaya to work with Dr. David Molesworth, the Medical Superintendent of the leper colony at Sungei Buloh, Kuala Lumpur, in which a community of some 3,000 lepers of Malay, Chinese and Indian nationality is cared for, and in which promising results with these drugs have already been obtained by Dr. Molesworth.

(*b*) *Loiasis*

The research project planned by Dr. R. M. Gordon, Professor of Entomology at the Liverpool School of Tropical Medicine, designed to investigate this infestation in the field, especially from the entomological aspect, as noted in last year's Annual Report, has now begun at Kumba in the British Cameroons. It has a resident entomologist, Mr. W. Crewe, and a pathologist will be added. Liaison visits for participation in the investigation were made by Professor R. M. Gordon, Dr. W. E. Kershaw, Dr. F. J. O'Rourke and Mr. R. B. Griffiths of the staff of the Liverpool School, and by Mr. H. Oldroyd, a taxonomist on the staff of the British Museum. Mr. P. J. Moore has been appointed as Laboratory technician in the Unit.

(*c*) *Filariasis*

The staff of this Unit, at Mwanza, Tanganyika Territory, has been greatly strengthened by the addition of a helminthologist, Mr. P. Sewell, M.Sc., two field research officers, Lieutenant-Colonel J. H. Cater, M.D., and Dr. Peter Jordan, M.B., and three laboratory technicians, Mr. R. R. Jones, Mr. H. M. Ross and Mr. W. Edwards. An entomologist, Mr. Alec Smith, will shortly be added, and thus bring the Unit up to full strength.

(*d*) *Virus Research Institutes*

The transference of the former Yellow Fever Research Laboratories at Entebbe, Uganda, and at Lagos, Nigeria, to become Virus Research Institutes under the Colonial Office, has now been completed. At the Entebbe laboratory the following staff changes and additions have been made :—

(i) *Additions to the Staff*:

E. S. Horgan, M.D., to be Director.
J. D. Gillett, B.Sc., to be Entomologist.
Andrew Buxton, B.A., to be Zoologist.

(ii) *Alteration of Titles of Appointment :*

A. J. Haddow, B.Sc., M.D., formerly of the Rockefeller Foundation, to be Epidemiologist.
W. R. Lumsden, B.Sc., M.B., to be Medical Entomologist.
G. W. A. Dick, B.Sc., M.D., and R. W. N. L. Ross, M.R.C.S., L.R.C.P., to be Medical Research Officers.

Throughout the year, Dr. Dick held a Rockefeller Fellowship for the study of virus techniques in the United States of America. The International Health Division of the Rockefeller Foundation, on relinquishing its control of the laboratory, very generously donated special equipment of several thousand pounds in value.

At the Lagos laboratory Dr. W. E. S. Merrett has been appointed to act as Director temporarily; Dr. F. N. MacNamara and Dr. P. B. Stones, both Medical Research Officers, were granted Rockefeller Fellowships for one year to enable them to gain experience in virus research in the United States. Mr. Kee Hock Ooi, B.Sc. (Hons. Zoology), University of West Australia, has been appointed Entomologist and has assumed duty.

(*e*) *East African Medical Survey*

Colonel T. J. Davidson resigned his appointment as Director. He has been succeeded by Lieutenant-Colonel W. Laurie, D.S.O., M.D., the Director of the Filariasis Research Unit. The original headquarters of the Unit were at Malya, in the Lake Province of Tanganyika. Accommodation was readily provided by the Government; but the population was widely scattered and facilities in general were meagre. The headquarters were therefore transferred to Mwanza, a town in Tanganyika at the southern end of Lake Victoria, with more adequate air, lake, road and rail facilities, giving access to populations larger and more favourably sited for long-term investigations. The progress of investigations has been seriously hampered by lack of suitable living and laboratory accommodation and the full staff sanctioned had not been recruited up to now on that account. At Mwanza temporary accommodation is now being provided in association with the Filariasis Research Unit and plans have been approved for the construction of permanent buildings for the full staff required. The scheme had been framed for development in three stages, the first of which will consist of sample surveys on vital statistics and factors affecting health, in selected areas. Sanction has now been given to the recruitment of expanded staff for the purpose of this Stage I, which will provide the personnel for a base laboratory and two field research units, and recruitment is being undertaken.

(*f*) *Malaria Investigation in Jamaica*

Dr. R. C. Muirhead-Thomson, who had previously studied certain aspects of malaria in West Africa and East Africa, has initiated in Jamaica a study of the infectivity and habits of the suspected malaria vectors, particularly in relation to housing and the possibility of control by residual insecticides. Despite the importance of African problems it is felt that the time has come to get a wider view of the whole malaria mosquito problem by extending the present range of research to other anopheles and other countries. One of the most promising of such fields is the West Indies. The important anophelines and the conditions under which malaria is transmitted differ widely throughout the area. Only in Trinidad and British Guiana has the malaria problem been tackled in a scientific way. Elsewhere, although malaira control schemes are in operation, it is quite clear that basic knowledge of the vector mosquitoes is almost completely lacking. There is nothing to indicate that the easy victory over *darlingi* in British Guiana will be repeated elsewhere; *aquasalis* in Trinidad, and possibly *albimanus* in Jamaica seem not to be very domestic, and their reactions to residual insecticides are quite unpredictable. Laboratory accommodation and certain junior staff have been generously placed at his disposal by Dr. T. W. J. Taylor, the Principal of the University College of the West Indies.

(*g*) *East African Bureau of Medical Research*

Dr. K. A. T. Martin has assumed duty as Director of this Bureau, with headquarters in Nairobi, Kenya. As a former Deputy Director of Medical Services, Kenya, his experience has proved of great assistance to the staff of the several research units in East Africa, and to the Committee in placing before it medical investigations desired by the East African Governments. He recently paid a brief official visit to the United Kingdom for discussions.

(*h*) *East African Malaria Unit*

This Unit has been established, with headquarters at Muheza, Tanganyika. Comprising four scientists it is directed by Dr. Bagster Wilson in the appointment of Inter-territorial Malariologist; his field of activity will be Kenya, Tanganyika and Uganda. Funds have been provided on a five-year basis from Colonial Development and Welfare funds, partly from the central research allocation and partly from the East African regional allocation. Its main functions will be to train personnel in the practice of malaria control, to advise on anti-malaria policy and the applicability of certain methods to particular problems, and to initiate research into the nature of the endemicity of malaria, the bionomics of the local vectors, and the role of the insecticides.

Research Laboratory at Freetown, Sierra Leone

7. The arrangements for taking over the laboratory were completed during the year by the Colonial Office. In the course of a tour in West Africa, Professor B. G. Maegraith inspected the laboratory and subsequently made recommendations for its opening as a research centre. The services of a member of the staff of the Liverpool School of Tropical Medicine were offered for the supervision of its re-conditioning and re-equipment, but the work has been held up pending the appointment of a Director, no suitable candidate having become available for the post so far. In view of the many important medical problems that exist in the area, the Committee are anxious that the laboratory should be opened as soon as possible.

Library Facilities

8. Through the courtesy of the Secretary of the Royal Society of Medicine, arrangements have been made for the research staff to utilise the facilities of the Photographic Unit of the Society; they include the provision of photostat copies of articles from the medical literature, photomicrographs, and line drawings.

Overseas Visits

9. Sir Edward Mellanby and Dr. R. Lewthwaite were official delegates of the Colonial Office at the African Regional Scientific Conference held in Johannesburg in October, 1949. Sir Edward was appointed Chairman of the Medical Section of the Conference. Subsequently, Dr. Lewthwaite visited Nyasaland, Northern Rhodesia and the East African territories in order to make personal contact with the research workers and the medical administrations there; he was accompanied by Dr. K. A. T. Martin while in East Africa. The visit of Professor R. M. Gordon, a member of the Helminthiasis Sub-Committee, to the loiasis project in the Cameroons has already been recorded. Professor G. Macdonald visited East Africa and spent a considerable time with the East African Medical Survey in the inception of which he had originally shown great interest. Professor B. G. Maegraith, in the course of a tour in West Africa as Nuffield Consultant, visited all research centres in the area with which the Committee is concerned, on their behalf. Professor B. S. Platt paid a prolonged visit to the Gambia and took part in the work of the Field Research Station at

Fajara ; he also visited the Field Working Party at Genieri to assist in directing their work. Dr. F. Hawking was in Tanganyika and Uganda up to April, 1949, when he returned to the United Kingdom on completion of his studies on the chemotherapy of Bancroftian filariasis and onchocerciasis. Sir Neil Hamilton Fairley paid a short visit to Egypt on behalf of the Medical Research Council to advise on the research work on schistosomiasis which is being undertaken there by the Council's team. As Professor P. A. Buxton had also visited the Sudan in connection with research on trypanosomiasis, with which however the Committee is not directly concerned, it will be seen that a majority of the Committee had been in contact with many phases of medical research in Africa and that some of them had taken a direct part in the work during the period.

REVIEW OF THE WORK IN PROGRESS

East African Medical Survey

10. Dr. Rosemary Jackson and Dr. R. J. Pitchford began the field survey work in January, 1949, in the Malya district. A group of some 1,400 were examined, most of them engaged in cattle breeding, and the cultivation of cotton and millet. Heights and weights were recorded by standard methods. Of 396 children under ten years of age, 87 per cent. showed splenic enlargement that was probably malarial. Corroborative evidence was found in the parasite indices ; infections were due to *P. falciparum* and *P. vivax* in equal numbers. Examination of urines for schistosomiasis, from 617 persons, showed an infestation of approximately 30 per cent. ; *S. haematobium* was the only species found. Umbilical herniae were noted in 46 per cent. of males and 23 per cent. of females ; they diminish with increasing age, and rarely cause inconvenience. In examinations of the male, hydrocoele was found in 8 per cent., and was probably a complication of filariasis. The Filariasis Research Unit examined 474 persons in the same population, and found that 25 per cent. had *Microfilaria bancrofti* in the night-blood films. The compilation of vital statistics in such primitive communities as were here dealt with was of necessity inexact. The only calendar known to the native is that made up of striking events, pleasant and unpleasant, such as " the year of the great famine ", or the number of times that a man has paid poll-tax. As the staff of the Unit approaches full strength a greater range of data and greater precision will be attained. For the present the following general observations have been made. Weaning appears to occur from the 24th-28th month, puberty in girls between the 11th-15th year, and the menopause in the second half of the fifth decade. From 705 married women pregnancy histories were taken, and are being studied alongside a series of 4,000 similar observations from another source. The total fertility was found to be 3,206 live births per 1,000 women. Ten per cent. of pregnancies fail to terminate in the birth of a live child. The infant mortality in the period before the completion of weaning is 22 per cent. ; by the time puberty has been reached one child in three has died. But, on available evidence, in spite of the high death-rate in childhood, the population in the particular area surveyed is increasing in number.

The Director of the Survey, Lieutenant-Colonel Laurie, is of the opinion that in the future one field team of the strength envisaged should be able to examine and take specimens from some 15,000 individuals in a year. One such team should soon be formed, with the additional appointments now imminent ; and the formation of a second field team will be unremittingly pursued.

Helminthiasis

(*a*) *Filariasis*

11. On the completion of the investigations on the chemotherapy of filariasis for which the Medical Research Council had deputed Dr. F. Hawking and

Lieutenant-Colonel W. Laurie to Tanganyika for a period of six months, the work was taken over by the Colonial Office, a Unit under Lieutenant-Colonel Laurie being constituted for long-term investigations on the epidemiology, prophylaxis and treatment of the disease. Headquarters have been established at Mwanza, Lake Province, Tanganyika, where temporary accommodation has been provided pending the construction of a permanent laboratory and houses for staff. The composition of the rest of the Unit has already been given in paragraph 6 (c). Much time has been taken up in making preliminary arrangements but it has been possible also to do a considerable amount of laboratory and field investigation during the year. It was necessary in the first place to establish standard methods which will be used in the examination of patients, the usual procedures employed in doing microfilaria counts in night blood having been found to give widely varying results in the same patient at successive examinations. The value of complement-fixation tests and skin tests with different antigens, for diagnosis of cases with negative bloods, is also under test.

12. *Chemotherapy.* In the preliminary therapeutic trials, the results of which have been published, it had been found that African subjects with bancroftian filariasis tolerated much higher dosage of Hetrazan than the level 2 mg/kg. which had usually been employed elsewhere, in prolonged courses. It was recognised that prolonged courses could not be practicable for mass use in Africa and, accordingly, investigations were carried out for the purpose of ascertaining whether high dosage for a short period or even single high dose treatment would be tolerated and effective.

13. The toxicity of Hetrazan was tested on 200 Africans, free from filariasis, by the administration of the drug in doses up to 30 mg/kg. Certain symptoms such as anorexia, nausea, drowsiness, headache and vomiting were noted with doses of 10 gm/kg. or over, but these were of irregular occurrence, of temporary duration and not serious. They were attributed to an action of the drug on the central nervous system. The excretion of the drug in the urine was shown to be fairly rapid and it did not appear that the toxic action of Hetrazan was likely to be cumulative. It was concluded that doses considerably higher than those usually employed could safely be given.

14. Groups of patients suffering from filariasis were put on courses of treatment with different dosage levels for varying periods and their blood examined daily for 7 days or more. The treatments used varied from single doses up to 30 mg/kg. to courses as long as 21 days at various smaller dosages. Further observation of cases will be necessary before the most suitable course can be determined, but an impression has been gained that high dosage for a relatively short time will be effective. An important point to be taken into account in fixing the dosage to be used will be the level of circulating microfilariae at which a patient becomes non-infective, if this can be ascertained. No definite information has yet been obtained on the lethal action of Hetrazan on the adult *W. bancrofti* although reports on the continued absence of microfilariae from the peripheral blood for very prolonged periods after treatment suggest that adequate courses may kill the adult.

15. Elephantiasis has been studied in the course of field surveys and microfilariae were found in the blood of 40 per cent. of cases examined. In view of recent claims that treatment with Hetrazan exercises a favourable action in the condition, ten cases were put under treatment, limb measurements and other observations being made. There were no early signs of improvement but the patients will be followed up. No action was shown on filarial hydrocoele.

16. During the year field surveys on the incidence of filariasis, as determined by the examination of night bloods, were carried out in several areas o Tanganyika. Excluding groups of less than 100 persons, a total of 2,865 were investigated; of these, 438 were infected with *Mf. bancrofti*, 25 with *Mf. perstans*, and 3 had a mixed infection. The highest incidence was shown in persons living on the islands or on the shores of Lake Victoria, and in Malampaka in Sukumaland which is liable to become waterlogged in the rainy season. A very low incidence was found in the dry Bukemba area. Distribution is related to high temperature and high humidity, the disease being entirely absent from hot arid areas and in places at higher level where the humidity is high but the temperature is low. Patchy distribution within infected areas may be related to the feeding and biting habits of the vector species.

17. The eventual object of the Filariasis Research team will be to establish the methods suitable for application in control of transmission of *W. bancrofti* infection. Mwanza was chosen as headquarters, partly for the reason that islands in Lake Victoria which are infected are specially suitable for carrying out control schemes, either by treatment which will render the individual uninfective to others or by measures for control of vectors. It is intended later to survey the incidence of the different forms of filarial disease in East Africa, to investigate the factors governing their distribution, the bionomics of the vectors, the development cycles of the parasites in the definitive and intermediate hosts, and other relative subjects.

18. The Unit received valuable assistance from Dr. W. D. Raymond, O.B.E., Government Chemist, Tanganyika Territory, who made estimations of the levels of the drug in blood and urine in eight series of patients receiving differing dosage. His principal finding was that a considerable proportion of the drug was excreted in the urine in the twenty-four hours following administration, which agrees with corresponding evidence from other groups of investigators in this field.

(*b*) *Loiasis*

19. The proposals put forward by Professor R. M. Gordon, of the Liverpool School of Tropical Medicine, for research on loiasis in the Cameroons, which he had visited in 1948 at the request of the Committee, were brought into effect in June, 1949. A laboratory was established at Kumba and Professor Gordon, along with Dr. W. E. Kershaw of his Department, initiated the work during a three months' visit, Mr. W. Crewe, who is undertaking the entomological side of the investigations being subsequently left in charge. It is intended that a medical officer will be appointed head of a research team but a suitable man is not yet available. Meantime the Director of Medical Services, Nigeria, generously lent the assistance of Dr. Zahra of the Nigerian Medical Service for a period, to help in certain aspects of the work.

20. During Professor Gordon's first visit in 1948 some of the breeding places of Chrysops, the vector species, had been identified and preliminary surveys had been made of the incidence of *L. loa* and other filarial infections both in human beings and in Chrysops. The infection rate in Chrysops appeared at the time to be higher than might be expected from the estimated incidence in man in the area. Further studies in 1949 showed that by the examination of larger quantities of blood and repeated tests on successive days the incidence in human beings was high. The risk of infection in the area is well illustrated by the fact that out of 20 Europeans showing no evidence of loiasis in 1948, no less than 6 were suffering from the disease in 1949, and it appears that most Europeans are likely to become infected after two tours in the area. It

is estimated that during June and July the potential risk of infection in the neighbourhood is one infective bite per week per head of the population.

21. Extensive surveys were made on the incidence of infection in the Kumba and Bamenda divisions and these are being continued by Dr. Zahra in less accessible areas. The detailed distribution is being correlated with the topography of the country, the movements of individual members of the population and with the present knowledge of the ecology of the vector. Observations made on the habits of Chrysops show that a slow flow of water is necessary for the development of the larvae and that they do not survive unless there is mud and decaying vegetation present. They have not been found in ponds, swamps, or other forms of standing water. The findings suggest that control of breeding may be possible by clearing and canalizing streams, particularly in the hilly area of Kumba. Before this is attempted much further research will be required on the life-cycle and habits of the fly. Studies on the life-cycle and feeding requirements are being undertaken by Mr. Crewe and also investigations on its length of flight, house-haunting habits and other matters which must be determined in relation to framing control measures. The preparation of minutely detailed maps of the area is being undertaken by the Government of Nigeria for the purpose of the work.

22. Mr. Oldroyd, of the British Museum (Natural History), also paid a visit to Kumba in the latter part of 1949 at the request of the Committee, to see the work on loiasis in the field, to collect flies and to advise on matters of identification and control. Five species of Chrysops were found in the area and it appears likely that the known or suspected vectors of *L. loa* may fall into the subgenus Kleineana. If this is correct it may be possible to eliminate the great majority of Ethiopian species from consideration as vectors of the infection. Further studies of the species will be made at the British Museum. In the course of his observations on the habits of Chrysops in Kumba Mr. Oldroyd noted that few could be found at ground level in the bush in the vicinity of known breeding-places. It is possible that on emergence they may ascend to canopy level : at that level they would emerge from the bush at the level of the European houses. Platforms at canopy level are being constructed for the purpose of observation on the point.

23. In his report to the Committee Mr. Oldroyd notes the wide distribution of Chrysops in Africa, including its presence in areas where loiasis is not a problem. The disease, on the other hand, is patchy in its occurrence, with certain ' black spots '. It may be that the important factor, particularly for Europeans, is whether there is opportunity for contact with the fly. In Kumba the siting of European bungalows may be the main factor. Various possible methods of control of spread of loiasis were considered and advised on by Mr. Oldroyd during his visit. These included clearing of breeding sites, the use of repellents and screening of houses. Extensive entomological collections were made during the visit.

The possibility of the existence of an animal reservoir of infection is being studied and a filaria has been found in a monkey which sufficiently resembles *L. loa* to deserve further study. The experimental studies in *L. carinii*, a filarial parasite of the cotton rat, which are being carried out at Liverpool by Professor Gordon and Dr. Kershaw, and in which Dr. D. S. Bertram was also engaged, will be of importance also in relation to research on loiasis and will provide comparative information on the stages of development, infecting doses and other points. The association with this centre of basic research from which guidance can be obtained will be of the highest value to the Unit at Kumba.

24. It is considered that, in view of the heavy risk of infection at Kumba, it would not be advisable to undertake treatment of Europeans without removing

them to a non-infected area. Hetrazan, a drug which has been shown to be highly active against the microfilariae of several species, will be tried in treatment in a small group of Africans living in an isolated, highly infected area, after determining the incidence of the infection and carrying out Chrysops surveys with subsequent observations on human and fly populations. A suitable centre for the purpose may be available at Sapele, where opportunities for the treatment of African employees of the United African Company have been promised.

25. Dr. Kershaw, at Liverpool, has found the antimonial drug, designated MSb., to protect against infection with *L. carinii* for a period of 6 months after a single injection and has further work in progress on the subject. In established *L. carinii* infections a single injection has been shown to kill the adult worm without effect on the microfilariae. This line will be followed up at Liverpool.

26. Pending the appointment of a pathologist as head of the research unit at Kumba Professor Gordon has lent the services of Dr. O'Rourke and Mr. Griffiths of his Department at the Liverpool School of Tropical Medicine for a period of three months' work in the Cameroons, from February, 1950, and, at the request of the Committee, Professor Gordon and Dr. Kershaw will pay another visit to Kumba in June, 1950, to advise on and take part in the investigations.

Malaria

27. *Malaya.* Dr. Field and Dr. Edeson of the Institute for Medical Research have continued their studies on the chemoprophylaxis and chemotherapy of malaria in Malaya under a grant from Colonial Development and Welfare funds. A third interim report on this work is being prepared.

28. *Chemoprophylaxis.* The Annual Report for 1948-1949 of the Colonial Medical Research Committee gave details of the trials of proguanil (Paludrine), mepacrine, and chloroquine on rubber estates in endemic areas. Owing partly to the continued low incidence of malaria, and partly to difficulties of supervision due to bandit activity, these trials came to an end in 1948 or early 1949. One trial not mentioned in the second interim report was a comparison of monthly doses of 400 mg. camoquin (CAM-AQI) against weekly doses of 300 mg. proguanil. The protection afforded by this dose of camoquin was not so good as that given by the weekly proguanil, but there was a significant reduction in overt malaria compared with a control group. A ' break-through ' of infection tended to occur in the fourth week after the last dose.

In the conditions prevailing at the time of the trials, with a low level of malaria transmission and partly immune populations, the suppressive value of a weekly dose of proguanil, mepacrine or chloroquine was fairly high, being greatest for chloroquine in doses of 250 mg. once a week. There was no significant difference in the suppressive activity of 100 mg., 200 mg., 250 mg. and 300 mg. of proguanil given once weekly. Most cases of overt malaria in the protected populations were associated with irregular dosage.

29. *Chemotherapy.* A most important and disturbing development in malaria therapy in Malaya has been the appearance of proguanil-resistant strains of *P. falciparum.* Failure to respond to a single dose of 250 mg. proguanil was first observed in October, 1948. The number of cases failing to respond to a single dose increased from that date until one case in every four so treated was a failure. ' Failure ' in this context means that asexual parasites were still found in the blood films on the 7th day of treatment, or that therapeutic intervention with some other drug was necessary before the 7th day. Single-dose treatment with proguanil has now been abandoned for this reason.

In April, 1949, the first failure to respond to a full therapeutic course of proguanil was observed, and there were 19 more cases by the end of 1949. A paper on this subject appeared in the British Medical Journal of 23rd January, 1950.

All the proguanil-resistant strains were found in patients from rubber estates, mostly from estates known to have used proguanil as a suppressive for 2 years or more. It seems probable that the emergence of resistance is associated with irregular proguanil dosage, for resistance has not been observed on the estates where the chemoprophylactic trials mentioned earlier were carried out. Proguanil-resistance in *Plasmodium vivax* has not been seen. As a corollary to this work it is clear that overt *falciparum* infection in persons who have been taking proguanil as a suppressive should be treated either with some other drug or with proguanil reinforced by some other drug at the beginning of treatment.

30. A single dose of 250 mg. chloroquine gave good results in *falciparum* malaria, but one case out of 90 showed a rising parasitaemia on day 7. No drug so far tested is regarded as completely safe when given as a single dose in *falciparum* infections.

31. The matter was the subject of a full discussion by the Malaria Sub-Committee which recognized that a factor existed that might affect the policy to be adopted in future in the use of the different available antimalarial drugs for prophylaxis and treatment. The experimental production of proguanil resistance in human subjects had been reported by Adams and Seaton and its production also in monkey and bird malaria by Dr. Ann Bishop and Dr. Hawking. The evidence brought forward from Malaya of its occurrence under natural conditions of use of the drug was supported by some evidence from East and West Africa and from Formosa, which was brought to the notice of the Sub-Committee.

It was recognised, however, that the full extent of the problem, its significance and importance, and the factors concerned, could not be assessed on the available evidence and that further investigations should be carried out in Malaya and elsewhere. The Sub-Committee were of the opinion that the subject would also require to be studied by experimental investigations in Britain, on human volunteers, on the lines that had been adopted at Cairns, Australia, and subsequently at Horton and elsewhere. It was considered that information on the production of resistance of the different stages of the malaria parasite to proguanil and other drugs might be obtained more quickly and more accurately in that way than by field investigations. The arrangements for the purpose are under consideration and will involve maintenance of malaria strains obtained from different regions and their use in the experimental studies.

32. *Malaria Control in Rural Areas.* An experiment in the control of malaria has been started in Malay rural areas in Negri Sembilan. Four valleys with similar topographical features have been selected. The vector of malaria is considered to be *A. maculatus.* In one valley a regular weekly distribution of proguanil has been arranged. In a second valley all houses are sprayed with DDT, in a third, with BHC (gammexane), while the fourth is untreated and serves for comparison. The incidence of malaria is estimated by examination of infant bloods once a fortnight, by blood films from all fever patients reporting to the dispensaries built in the valleys and by spleen and parasite surveys of the populations twice a year. Experimental control started in August, 1949. No assessment of results is yet possible.

33. *Effect of DDT and BHC on Malayan Mosquitoes.* Mr. Wharton and Mr. Reid of the Division of Entomology are responsible for the entomological

aspects of the insecticide work. With the aid of a small preliminary grant, Muirhead-Thomson's trap-hut technique was used to test the effects of DDT and BHC on *Anopheles maculatus*. Wettable powders of both insecticides were effective, and doses of 200 mg. per sq. ft. of DDT and 40 mg. of gamma BHC killed respectively over 80 and over 90 per cent. of all *maculatus* which entered the huts during 16 weeks after treatment, by which time mosquitoes were too few to continue the experiment. During the first eight weeks or so BHC killed many *Culex fatigans*, but this species was not killed by DDT, though like *Anopheles gambiae*, it was driven out of the DDT-treated hut. A short account of these results was published in a letter to Nature of January, 1950. A full account by Mr. Wharton will appear in the Bulletin of Entomological Research. These experiments are being repeated to define the effective duration of these and other doses of DDT and BHC against *A. maculatus*. They are also being extended to other vectors of malaria such as *Anopheles umbrosus* and *barbirostris*, and to the vectors of filariasis (*Mansonia* species).

34. Houses in the experimental valleys are being sprayed with wettable powders of DDT and BHC once every three months, using the same doses as in the trap huts. Routine entomological checks are provided by night-catching of anophelines with a human-bait net-trap, with dissection of the catch, by larval surveys, and by pyrethrum " knock-down " spraying.

35. *North Borneo.* Malaria research in Borneo in 1949 has continued at the headquarters in Labuan, by the Unit under Dr. J. A. McArthur, and at Tambunan in the interior. In Labuan, studies have been carried out on *A. leucosphyrus* and *A. sundaicus*. *A. leucosphyrus* has continued to show itself the chief vector there, as in most parts in Borneo. The place of *A. sundaicus*, however, remains rather uncertain. After many years, during 1949 sporozoites have at last been demonstrated in this species in Borneo, firstly by the Oilfield's medical staffs in Sarawak and Brunei, and almost simultaneously by the Malaria Research Department in Labuan. This proves it a vector; but whether it is always so appears doubtful, and the circumstances in which it is so remain to be defined.

36. Work in the interior—interrupted by the war—has been restored with the establishment of the Tambunan Experiment. This is directed to show whether very limited jungle clearance over *A. leucosphyrus* breeding places results not only in *A. leucosphyrus* control, but in malaria control. A highly malarious valley has been selected, in which *A. leucosphyrus* is the only vector, and in which degree of malaria—in some villages 100 per cent.—has been observed now for a number of years. In this valley a thorough *A. leucosphyrus* larval survey has been made, and jungle has been cleared to admit sunlight to actual breeding places. The clearing has been relatively small, for virtually no change is recognizable in the landscape, but an area of nearly 10 square miles has been influenced, and some 32 miles of stream. As a result of the clearing, which employed 50 men 3 months, some 95 per cent. of *A. leucosphyrus* control appears to have resulted. It is considered that it will be necessary to re-examine the area every 6 months or so for possible recurrence of shade; and it is proposed to make 6-monthly spleen and parasite examinations in the controlled area, and in an uncontrolled neighbouring valley for comparison. It is hoped that some effect on the parasite rates may be observable within—say—12 months, and on the spleen-rates within perhaps 18 months or so.

37. A study has been completed for publication of the records from the whole of Borneo, and for the first half of the 20th century, regarding the distribution and intensity of malaria, the Borneo epidemics, the parasites, the recorded anopheles identifications, and the mosquito dissections of Borneo.

As a result of this work the previous conclusions are adequately confirmed ; that Borneo is a vast reservoir of hyperendemic malaria with a few healthy areas ; that 42 species of anopheles appear to have been recorded with some degree of probability, 29 of which can be accepted with fair confidence ; that infection is maintained chiefly by the shade-loving *A. leucosphyrus*, and to a lesser extent by the *A. umbrosus* group, and should therefore be controlled by judicious clearing ; that certain coastal areas may be threatened periodically by epidemics due to *A. sundaicus*, often fresh-water-breeding ; that *A. baezai* appears to have some place in transmission ; that a number of other species are under some suspicion ; and that *A. maculatus*, previously often claimed to be the chief vector in Borneo, appears to have little and probably no relation to Borneo malaria.

Virus Diseases

(a) The Yellow Fever Research Institute, Lagos, Nigeria

38. *Yellow Fever.* The Institute stocked yellow fever vaccine manufactured at the Rockefeller Laboratories, New York City, for issue to the West African Colonies, and maintained checks of potency. Yellow fever vaccine for administration by the scratch technique, either alone or combined with vaccine lymph, was manufactured at the Institute in increasing amounts during the year. Various factors were studied for their effect on the retention of potency in storage : these included the effect of storage of yellow fever vaccine pulp in the undesiccated state alone or mixed with gum arabic, and the effect on vaccine lymph of storage in the desiccated state with and without the addition of glycerin, as, with the latter addition, it could not be desiccated satisfactorily. It had been found that storage of the mixture of calf lymph with 0.5 per cent. phenol-saline at 40° F., resulted in a fall of the bacterial count to accepted limits in two months. After two months subscquent storage, either in the desiccated or the undesiccated form, potency was satisfactory. Potency checks will be continued up to a year.

39. Trials on infants with the ' scratch ' vaccine, for the preparation of which glycerinated vaccine lymph was used, showed a conspicuous fall in vaccine potency to have occurred in six months. The titre of the sera of the vaccinated infants against yellow fever virus will be tested later. No unfavourable reactions were observed. A small group of adults who gave negative mouse-protection tests became positive two months after vaccination with the combined product. Tests on an extended scale will be carried out with vaccines prepared in different ways to determine the most suitable procedure of manufacture. The evidence obtained so far suggests that 0.25 per cent. phenol has little or no effect on yellow fever virus in the presence of gum arabic ; 0.5 per cent. has a very slight harmful effect if any, but over 0.5 per cent. phenol causes a loss in titre. Mixture with glycerinated calf lymph appears also to cause a loss in titre.

Arrangements were made for the vaccination of large groups of workers at the Konongo Gold Mines, Gold Coast, with both the yellow fever and the combined vaccine, under conditions which will permit of continued observation.

40. *Rabies.* A study has been commenced on the local strains of rabies virus of which 5 dog strains have been ' fixed ' by mouse passage. One human strain is also under study. Tests of the susceptibility of local primates and rodents have been carried out. Investigations on the preservation of the Paris virus by lyophilisation are being undertaken.

41. *Filariasis.* A small number of cases of loiasis have been treated with Hetrazan, the dosage employed in most cases being 3 to 6 mg/kg daily for 7

days divided into three daily doses. It has been confirmed that the treatment causes rapid disappearance of the microfilariae from the blood. The cases will be followed up to determine the end results. The reactions experienced were mild.

(b) The Yellow Fever Research Institute, Entebbe, Uganda

42. At the close of 1949 the Yellow Fever Research Institute underwent a change in identity and administration and in the scope of the work to be carried on by its staff. At this time the Rockefeller Foundation withdrew from participation and the Colonial Office assumed responsibility for its staffing and activities. The new name will be " Virus Research Institute " and according to present plans its programme will embrace investigations in the field of East African virus and Rickettsial diseases.

43. The establishment of the Yellow Fever Research Institute was conceived and begun in 1936, as a joint venture of the Foundation and the Uganda Government, with the object of investigating the epidemiology of yellow fever in East Africa ; although the Foundation has been the chief contributor, contributions to the maintenance of the Institute have also been made by Uganda and the other East African territories. In a large measure the objective has been attained. Studies have indicated that yellow fever is endemically maintained in Uganda in a monkey-mosquito forest cycle ; the infection of humans would seem to be incidental events which, clinically, are rarely suspected. The presence of the virus has been unequivocally established by its isolation from man and from wild-caught mosquitoes. Two species of mosquitoes, *Aëdes simpsoni* and *Aëdes africanus* have been definitely incriminated as vectors of the infection, the latter of the endemic sylvan disease among monkeys and the former of the infections in humans ; the habits of these insects are in accord with their respective epidemiological roles. A considerable quantity of data concerning the mosquito fauna of Uganda has been incidentally amassed.

44. Much information has been gained, during the past thirteen years, relative to the distribution of yellow fever immunity in East and Central Africa, through protection tests carried out at the Institute, and the results of surveys have indicated the presence of the virus in the East and South to a degree that had not been previously realised. The endemic zone, as outlined by points at which immune sera have been found, is a large area, reaching the Red Sea coast of Ethiopia and the coasts of Kenya and Tanganyika in the east, and has its southern most point well within Bechuanaland borders. In the course of attempts to isolate the virus of yellow fever, other previously unknown filterable agents have been isolated and subsequently studied.

45. During the current year investigations on the distribution of *Aëdes africanus and Aëdes simpsoni* have continued, covering many parts of Uganda, and also all the main groups of islands lying within the Uganda territorial waters of Lake Victoria. The results confirm that both species are widely distributed in lowland areas and that they reach their extinction level at a height of roughly 5,000 ft. Both are present on all the main island groups but, while *A. simpsoni* is scarce on the islands, *A. africanus* is exceedingly prevalent in most cases. Further, it has been confirmed that both these mosquitoes can adapt themselves to conditions apparently very unfavourable, and that *A. africanus* at least can survive any ordinary dry season in the adult state.

46. The immunity survey among humans this year has revealed no particularly significant results. In addition to Uganda, the territories of Tanganyika, Northern and Southern Rhodesia have been included in the survey. In all the lowland areas in which monkeys have been collected in adequate numbers,

some sera have been found to contain antibodies against yellow fever. A small additional sample from the Ruwenzori Mountains (collected at heights over 5,000 feet) confirmed that this area is negative for yellow fever. The most interesting finding is that in the Jubiya forest area a considerable percentage of the monkeys are immune. The presence of immune subadults in our sample from this locality shows that yellow fever has been active there very recently. It may be noted also that immune monkeys occur on many of the islands on Lake Victoria.

Preliminary experiments on the dose of virus injected by infected *Aëdes aegypti* at the time of feeding indicate that this may be as high as 100 MLD. These experiments are being continued.

Hot Climate Physiology

47. With the laboratory at Oshodi, Nigeria, now completed and equipped, it has been possible to develop research work on a considerable basis. The following is a summary of some of the studies made.

48. *The ability of native-born West Africans to work in severe heat and humidity.* Investigations were carried out for the purpose of trying to determine whether West Africans, born, living and working in a hot humid climate, have, in comparison with men born and bred in a temperate climate, some degree of acclimatization acquired during the course of their life or whether they have an inborn inherent acclimatization possibly peculiar to their ethnic group. Estimations were made on inherent acclimatization and also on the effect of artificial acclimatization by exposing groups of local Africans to severe heat and humidity in an experimental chamber in which regulated work was done. Their reactions were measured by tests for sweat and salt loss, rectal temperatures, blood changes, etc. and comparison was made with the findings in British service personnel submitted to identical conditions in London during the war. The tests for inherent acclimatization showed that West African subjects who had never previously been exposed to severe heat and humidity react more favourably than do unacclimatized Europeans : their physiological reactions were equivalent to those of Europeans on their 2nd or 3rd day of artificial acclimatization. While many of the European subjects under study did not complete their exposure tests, none of the West African subjects dropped out voluntarily. In comparison with unacclimatized Europeans, the West African subjects were partially acclimatized.

49. The question arises whether this inherent acclimatization is an inborn characteristic or whether it is acquired by each individual as a result of his life under the conditions of temperature and humidity of West Africa. The studies on sweat and chloride loss which were made suggested that the control mechanism for sweat and salt loss works somewhat differently in Africans and Europeans, but the results do not make it possible to say whether the difference is inborn or acquired. It was considered that, if there is no real difference between the capacity of West Africans to work in the heat as compared with Europeans, then the inherent acclimatization of 2 or 3 days which is found in Africans represents an acquired acclimatization : if this is so, subjecting Africans to a full course of artificial acclimatization would not increase their tolerance beyond that of fully acclimatized Europeans. On the other hand, if this inherent acclimatization represents an inborn difference between Africans and Europeans, the difference would still be apparent when both were fully acclimatized. To test this, West African subjects were given a full course of artificial acclimatization and their reactions were studied by various biochemical and other tests. A comparison of the sweat rate/rectal temperature curves of partially and fully acclimatized Africans and Europeans showed that

there were some differences between the two groups. Fully acclimatized Africans sweated at the same rate as fully acclimatized Europeans, but the Africans began to sweat at a lower rectal temperature, reached their maximum sweat rate sooner, and at a lower rectal temperature, and their sweat glands became fatigued sooner. The chloride content of the sweat of the Africans was lower than that of Europeans under the same conditions. Significant changes in plasma volume were observed during acclimatization but no changes in blood chemistry. The causes of these differences have not been elucidated, but as they are exhibited by fully acclimatized subjects, it cannot be acclimatization. The point can only be settled by tests on residentially acclimatized Europeans.

50. The earlier fatiguing of the sweat glands of Africans may be the reason for the frequent rests indulged in by Africans during strenuous work and the expression of a physiological need. It might be possible to determine, experimentally, the optimum and rest cycles for different occupations under different climatic conditions and the suitable length of shifts to be worked. The average salt intake in Nigeria was low compared with European standards. The low sodium chloride content of sweat found may be due to low intake, and small sweat losses may enable a balance to be obtained, or the low salt intake may be due to a smaller physiological need. Cramp from salt loss was not shown by any of the Africans. The possible reasons for this are being investigated.

51. Considerable attention in the laboratory studies is being paid to sweat rate, as it is considered that the sweat rate is the most reliable indication of thermal stress and that, if the mean sweat rate of a group of workers exceeds 1,000 c.c. per hour, either the work is too hard or the conditions too severe. Sweat rate is, however, difficult to measure under field conditions and, as it is well correlated with rectal temperature, the rectal temperature can conveniently be taken as an indicator. The figure recommended to be taken as an indication of thermal stress is a rectal temperature of 100.2°F. or over. This is found to give a good correlation between the subjective impression of men being under thermal stress and its objective measurement.

52. *The effect of arterial occlusion upon the sweat rate and sweat composition.* Experimental studies were made with the object of ascertaining certain points in the mechanism of sweat production and concentration and, in particular, the occurrence of sweat gland fatigue. Arterial occlusion was found to reduce both sweat rate and chloride concentration, but 15 minutes after restoration of the blood supply, sweating was resumed at the same rate as in the control and chloride concentration was temporarily increased, the ultimate result being a balance. During arterial occlusion it might be expected that sweat would be of higher concentration than normal, but on the other hand, as the glands were not secreting so fast during occlusion they would have a chance to recover from fatigue : a lower concentration of chloride would accordingly be expected when circulation was restored. The very transient nature of the effect found is suggested to indicate that there might be other and more influential factors besides fatigue and oxygen lack affecting the composition of sweat when the body temperature is at any given level.

53. *Metabolic costs of common tasks.* The studies on the subject have been continued but results cannot yet be reported. In relation to it a new project for ascertaining local dietary intake has been initiated in order that the respiratory quotients observed may be checked. Complete daily intakes are being collected from three Institutions and one private individual on which the fat/protein/carbohydrate ratio is being determined. Some analyses were made on duplicate samples in the Experimental Medicine Laboratory, Cambridge, by courtesy of Professor R. A. M. McCance.

54. *Daily sweat loss in routine tasks.* Estimations were made of the sweat loss of outdoor and indoor labourers engaged in light work during the dry season in Lagos in an eight-hour day. It was calculated that the outdoor worker lost 2½ litres of sweat containing 2.6 gm. of sodium chloride in the period and the indoor worker 1¾ litres and 1.8 gm. These figures were considered to indicate that the salt loss at the rate of work common to West African labourers was not serious. On the other hand, in occupations in which frequent rests out of the sun cannot be taken, sweating may be profuse and salt loss considerable. This point is being investigated. In the cooler wet season sweating was negligible.

55. *Blood chemistry.* In view of the generalizations sometimes made that the West African people are under-nourished and anaemic, factors which might affect their performance in heat and their working capacity, investigations were commenced first on their plasma protein concentration and haemoglobin content of blood. A preliminary series of estimations was made on a small series of subjects mostly of low economic status. Plasma protein levels were found to be high, though just within normal limits, but haemoglobin levels were, if anything, lower than normal; a larger series will be examined to ascertain the general applicability of the findings and possible causes of difference.

Physiological Research at Makerere College, Uganda

56. During the year Dr. E. G. Holmes, in collaboration with Mr. F. L. Gee (Reader in Physics at Makerere College) and a number of students in the Physiology Class, have studied the red blood cell counts of Makerere College students. Mr. Gee has undertaken the statistical treatment of the results. It was found that the mean red cell count of these students was 5.95 million per cmm.; this figure agrees well with that for red cell counts at similar altitudes in other parts of the world (for which the data were collected from the literature in sufficient detail to allow of a red count/altitude curve to be constructed). The data for other East Africans found in the literature are 4.56 million (Kampala), 5.02 million (Nairobi) and 5.57 million (a small group of railway workers in Nairobi living under special conditions). The living conditions and diet of the Makerere students are accurately known, so that these results may be of some importance. They were communicated at the Johannesburg Conference, and will be published in the East African Medical Journal. The contrast between the students' red blood cell counts and those of the general population is striking.

57. Dr. Holmes, with the assistance of Mr. John Kyobe (African technician), has carried out a series of blood counts on surgical out-patients at Mulago Hospital, who were suffering from minor complaints not calculated to affect the blood picture. The results are now being dealt with statistically by Mr. Gee, and will be published. It may be said, meanwhile, that the mean red cell count was 5.2 million. It is hoped to obtain information from these data about the effect of such factors as diet and occupation on the red cell count. Dr. Holmes has also studied the serum protein of this group. He confirms the findings of others that there is a marked increase in the globulin fraction; indeed the mean A/G ratios do not reach unity until the mean red cell count is 5.5 million or over. In collaboration with Mr. Semambo he is carrying out a series of fractionations of serum proteins by the " Span-Ether " method; he hopes to extend this by the more satisfactory low temperature/alcohol method. Dr. Holmes, Miss Margaret Stanier (lecturer in Physiology at Makerere College) and Mr. Jones have carried out nitrogen balance experiments on a series of patients. They have also made observations on blood volume, total fluid volume, and extra-cellular fluid volume. The results are comparable

with those obtained by other workers, except that they indicate an extraordinarily prolonged period of positive nitrogen balance when protein is given, with a gradual decrease of extra-cellular fluid volume per cent. of body-weight. Presumably this indicates preceding protein deficiency of a very severe kind. These observations have been carried out in the general wards of the hospital. Their extension, with great technical improvement, is hoped for once the " metabolic ward " is in use. Various other points are being investigated, of which space precludes the mention in this report.

58. Dr. H. Lehmann continued his investigation of anaemia in Africans. He concluded that earlier work had indicated that anaemia in Kampala was almost entirely due to parasites, malnutrition playing at most an aggravating rather than an essential role. Hookworms were the most important cause of anaemia, malaria was frequently the cause in pregnant women and in infants, and bacterial infection too could cause an anaemia of intravascular blood loss with jaundice, reticulocytosis and macrocytosis. This macrocytosis was not due to a deficiency in dietary factors, but was due to the emission of reticulocytes and early post-reticulocytes from an efficiently working bone-marrow, which attempted to cope with a blood loss in the periphery which was either extra-vascular (hookworms) or intravascular (malaria and bacterial infection). The ensuing blood picture was one of early, not full " finished " erythrocytes, differentiated from that of tropical megalocytosis and named " precoctic " (coctus =fully mellowed). The appearance of the blood-slides and the reticulocyte percentage, the bone-marrow findings and the response to iron and worming was the same in areas as widely apart as Kisumu in Western Kenya, Dar-es-Salaam in Tanganyika, and in Fort Portal and Gulu In Uganda. Nowhere was there found a nutritional macrocytic anaemia.

59. Studies of the " Iron Deficiency " widely found in Uganda showed that it was at least in large part due to hookworms rather than to a deficiency of iron in the diet. Whereas Indian school-children at Kampala were found to have the true dietary iron deficiency anaemia known in Europe, and reported by Hynes in North-West India, the " iron deficiency " anaemia in Africans is quite different, in its blood-picture and its only partial response to iron ; it is considered rather to be due to the prolonged blood loss of hookworm infestation, with its sequel of inadequate reabsorption of iron. Detail of the investigations has been published in the medical literature during the year.

60. Concerning sickle-cell anaemia, this proved to be almost entirely absent in Uganda ; studies of the correlation of anaemia and sicklaemia revealed that the former was due to causes other than the sickle-cell trait. A survey made in collaboration with Dr. A. B. Raper of some 5,000 individuals in Uganda and some of the neighbouring territories indicated that the incidence of the sickle-cell trait was tribal, that it is the higher the less Hamitic the tribes are racially and may well be a useful pointer to the classification of a tribe as Nilotic or Hamitic.

A haemoglobin survey of migrant labourers from Ruanda Urundi was continued jointly with Dr. J. Hunter, the Senior Medical Labour Officer. Some 5,000 individuals were tested. The incidence of anaemia (below 12 gm. per cent.) was unexpectedly low, being well under 2 per cent.

61. Dr. Holmes was a delegate of Makerere College at the African Regional Scientific Conference held in Johannesburg in October, 1949. Early in 1950 Mr. Y. Semambo was appointed to the research staff as an African Research Scholar. The laboratory has given hospitality to Dr. Margaret Thompson who is working with Dr. H. C. Trowell on infant nutrition. Mr. E. R. Jones, lately of the Veterinary Department, Uganda, joined the unit in September, 1949, with the rank of Senior Technician.

Preparation of precipitin sera

62. The project for developing methods for the preparation of highly specific precipitin sera for use in the diagnosis of the blood meals of biting insects, a valuable agent in the study of the epidemiology of insect-borne diseases, was continued during the year. The work was carried out by the Lister Institute at the request of the Committee. As Mr. Bernard Weitz, M.R.C.V.S., who had been employed by the Institute specially for the work, had obtained considerable success in his investigations, it was decided that he should visit East Africa to extend the range of species for which precipitin sera would be prepared and be made available. Mr. Weitz accordingly paid a visit to East Africa for a period of three months from the beginning of February to the end of April, 1949, where he obtained the assistance of the Medical Department, the Tsetse control and research organizations and the Game Preservation Departments in Tanganyika and Uganda in arranging safaris for the collection of blood of game and other animals. Many difficulties were experienced and overcome in collecting, separating, storing and transporting sera in sterile and satisfactory condition and useful quantities were collected from at least 25 species of mammals. Much experience was gained on the suitable technique and requirements for collection which will provide a guide for future operations. The sera brought back to England have been stored at the Lister Institute after inspecting and refiltering if necessary, and will be kept freeze-dried in sterile ampoules of small size.

63. The material collected forms only a proportion of the range required for the work planned and it is considered necessary to augment and replenish existing stocks. Proposals have therefore been put forward for undertaking more extensive collection with the assistance of the East Africa Tsetse Research Organisation, provision of the necessary equipment and transport being planned on the basis of the preliminary experience. The material will be despatched to the Lister Institute and used there for the production of the precipitating antisera. For this work, owing to the possible risk of introducing live virus of animal diseases, special provision has been necessary for isolation of animals used for the work at the Institute. The precipitin sera will be made available for workers on malaria, trypanosomiasis, yellow fever and other virus diseases, and the large range of infections transmitted by biting insects.

64. Since the beginning of the work more than 3,000 mosquito feeds have been examined with antisera produced from the blood of domestic animals and man, in collaboration with Mr. Senior White in Trinidad. The results of these tests have been extremely encouraging. One of the notable features has been the observation of multiple host feeds in the species of mosquito tested (*A. aquasalis*). Some preliminary tests have already been made on tsetse flies sent from Zanzibar, where the importance of the bush-pig as host for *Gl. austeni* has been noted.

Relapsing Fever

65. Dr. G. A. Walton has continued his investigations of tick-borne relapsing fever, which have as their first objective a study of the bionomics of the vector, and as their ultimate objective the devising of counter-measures against the disease that will be based on tick-control. His headquarters are at Kerugoya, some 80 miles from Nairobi, Kenya, where a laboratory has been specially built for this work, and African assistants trained. The Location Headmen in distant areas visited receive instruction in the search for ticks.

66. The observations in various districts, that were mentioned in the Annual Report of last year, have been continued and extended. In one small focus of the disease around Igoji the local strain of *Spirochaeta duttoni* appears to

exhibit unusual strain specificity; and the natives of the area maintain that it is transmitted by a tick other than *Ornithodorus moubata*. This local information is being sifted for any scientific basis that may support it. A study of the factors governing the strikingly fitful incidence of tick-infestation in adjacent huts is being undertaken; such factors include the indoor tethering of cattle and the non-disposal of dung, the structure of the mud bed, the indoor storage of food, and the effect of rains or drought.

67. In an attempt to simulate the microclimate and assess its environmental influence on breeding, 168 ticks collected from the village of Antibociu near Maua were kept in a jar of fine soil taken from the huts. The mouth of the jar was closed with a cotton-wool plug, a few drops of water added to maintain a humidity of more than 80 per cent., and kept in an incubator at a constant temperature of 77°F. The ticks burrowed into a moist soil and made round cells which they filled with eggs. At the end of three months the 105 female ticks present had produced 52,115 first-stage nymphs, which gives some indication of the rate of increase under favourable conditions, and of the effect upon such a possible increase in the native huts of all adverse factors which keep down the numbers.

68. Since December, 1949, Dr. Walton has been investigating the endemic focus of relapsing fever in the South Nyeri Native Reserve, which is the biggest focus in Kenya. He examined 2,125 huts, and mapped out the infested area. The results are now being analysed. Colonies of ticks from Tanganyika and elsewhere in East Africa have been received at the laboratory and will form part of a live collection from all known endemic foci in that region.

Scrub-typhus

69. As noted in last year's Report, Dr. J. R. Audy, Mr. J. L. Harrison, and Mr. K. L. Cockings comprise a field research unit that is based on the Institute for Medical Research, Kuala Lumpur, Malaya; this unit is making a long-term study of the disease. Liaison with the staff of the Institute and with the United States Army Scrub-Typhus Research Unit has been close. Of the field investigations during the year, probably the most interesting has been a 10-day visit of the unit to Pulau Jarak, a tiny island uninhabited by man, in the middle of the Straits of Malacca. About 15 years ago, a party of naturalists visited the island in order to collect specimens for the Kuala Lumpur Museum; four of the seven members contracted scrub-typhus. The present expedition was designed to elucidate the circumstances of that event. A detailed report will in due course be issued. A few salient features are noted here.

70. The island proved to be of an oceanic type with a wholly introduced flora and fauna; it consisted of a pile of granite boulders held together by tree roots. It was half a mile long, 600 yards wide, and 500 feet high, and largely covered by forest. Its rat population provided interesting study; completely ignoring the ten human intruders, the rats in fantastic numbers showed no sense of danger, and swarmed over any recumbent visitor. Every rat examined had in its ears hundreds of scrub-typhus mites against which the scientists were protected by clothing impregnated with the mite-poison dibutyl phthalate. In species they were allied to the Malayan house-rat rather than to the cosmopolitan ship-rat. Apparently, having no enemies, they had complete freedom to live, eat and breed, and had reached a population at least ten times greater than that on a piece of land of corresponding size on the mainland.

71. Concerning the mites, these were almost all of the species *Trombicula deliensis*, but a few *Walchia rustica* and other species were found. A Forest

Officer, Mr. J. Wyatt Smith, accompanied the party and made observations of the nature of the forest. Amongst a large collection of scientific specimens brought back to the mainland for further study were the skins and skulls of rats, live rats with live mites on them, live and dead mites in specimen tubes. The island will be revisited from time to time.

72. The breeding of mites through their life cycle in the laboratory has been continued by Mr. Cockings with increasing success; and Dr. S. R. Savoor, the Senior Pathologist to the Institute, is collaborating in attempts to infect laboratory mice with larvae, nymphs, adults and eggs.

Mr. Harrison has continued his work on the identification of rats. He finds that, although a great many rats and similar animals are recorded from Malaya, only six species are of practical importance as pests of houses or fields. These species are (Rodentia, Muridae) *Rattus rattus* (in three forms), *R. norvegicus*, *R. exulans*, *Mus musculus*, *Bandicota bengalensis* and (Insectivora, Soricidae) *Suncus caeruleus*. Keys to the external characters and to the skulls of these species have been prepared and published.

73. The success of the therapeutic and prophylactic uses of the recently introduced antibiotic Chloromycetin as counter-measures against scrub-typhus, and its beneficial effect in the treatment of typhoid fever, which were obtained in Malaya by a Unit of the United States Army Research and Graduate School, Washington, D.C., under the direction of Dr. Joseph E. Smadel, were summarized in last year's Annual Report. Inevitably many interesting avenues of research were opened up thereby, and the Director of the Institute for Medical Research welcomed the return of the Unit for a second and third visit, late in 1948 and 1949, respectively. This most stimulating and profitable collaboration has thus continued, to the gain of the individual scientist, the civilian and the soldier alike. A series of reports on the work are now appearing in the medical literature; a few salient observations are noted below.

74. The success of chloromycetin in the treatment of scrub-typhus, reported last year, has been amply confirmed. Studies in the chemoprophylaxis of the disease at first achieved only temporary suppression of the clinical signs and symptoms. In a later field trial a series of 31 volunteers received weekly oral doses of 4.0 gm. for 6 weeks, the first dose being taken either immediately after, or, alternatively, 4 days after, an effective period of exposure in a hyper-endemic area. Only one volunteer developed the clinical syndrome sufficiently to require hospitalization. All others remained ambulatory, a mild fever occurred in one half of them on the day before the next prophylactic dose was due, or on that actual day, but responded promptly to this prophylactic dose. Occasionally the causal Rickettsia could be isolated from the blood at this time. None of the 30 developed any clinical manifestation after completion of the course of prophylaxis. The importance of this finding to the soldier on operations, or to civilians " at risk " for short periods, is clear. Further problems arising from this finding are now under investigation by the Unit in Kuala Lumpur and in Washington.

75. Inferences from these and other observations have led Dr. Smadel and his colleagues to incline to the view that Chloromycetin does not " cure " the patient by any direct destructive action of its own on the Rickettsiae, but that it is effective because it suppresses multiplication of the organisms until the patient can develop his own immune and defence mechanisms; and that these control the infection permanently.

76. Aureomycin, another antibiotic, prepared by fermentation methods from another mould, proved to be equally as effective curatively in scrub-typhus as is Chloromycetin.

77. In studies on typhoid fever the important problem of the considerable incidence of relapses in cases treated with chloromycetin has been under constant review by the American Unit. While it is yet too early to be dogmatic on the formulation of a standard dosage, it is felt that treatment is necessary for a longer period than the 8 days originally suggested; and that the following revised dosage, calculated on the basis of approximately 50 mgm. per kgm. of body-weight, will lessen the number of relapses: an initial oral dose of 4 gm. is given, followed by 1.5 gm. at 12-hour intervals until the temperature becomes normal (usually 4 days), then 0.75 gm. at 12-hour intervals for 7 more days, followed by 0.5 gm. at similar intervals until the 14th-18th day. Clinical data and laboratory experiment have led to the conclusion that the carrier state is unaffected by the drug; there is no evidence as yet that its incidence is increased.

Nutrition

78. In the reports of the London School of Hygiene and Tropical Medicine for 1947-48 and 1948-49, Professor B. S. Platt has reviewed the work done under his direction on nutrition problems in Colonial Territories. These statements supplement and bring up to date the accounts given in previous reports of the Colonial Medical Research Committee. A record of recent publications and a list of the staff engaged in research, field investigation and teaching in the various branches of the central organization are included in the latest report. The Human Nutrition Research Unit is now established in the Medical Research Council Laboratories at Hampstead.

79. A leading article in a recent number of the Lancet (May 27th, 1950, p. 1002) has been devoted to some new developments in nutrition research in relation to investigations now being made in the Unit and in the Gambia; a short preliminary paper on this work which is concerned with changes in enzymic activities in the blood and tissues of young children not receiving enough protein in their diets has been published (Lancet—May 13th, 1950, p. 908).

80. The three-year period for which funds for the Nutrition Field Working Party had been allotted ended early in 1950. A Colonial Office committee and the Gambia Government are considering the future of this work on village improvement. Observations of considerable interest and significance have been made in the course of the survey and preliminary experiments made at Genieri and in the neighbouring control villages; further comment is however deferred until the examination of all the results obtained is completed and written up.

81. The study of malnutrition in the Gambia is almost always complicated by the co-existence of one or more of several zymotic diseases. In the work at Genieri the main emphasis was laid on the improvement of health by better feeding. At Kennaba in Western Kiang the prevalence of malaria, trypanosomiasis, filariasis and ankylostomiasis has been determined. With the cooperation of the Medical Department, control of these diseases is being attempted and the effects of reduction of parasitisation on the state of nutrition of the villagers will be assessed. This investigation is being supported by investigations at the Field Research Station at Fajara and by experimental work in laboratory animals at Hampstead on the effects of diet on immunity to disease.

82. Investigations are proceeding on the application of recent work on the estimation of amino-acids to the analysis of the proteins of Gambia dietaries, particularly of millets and sorghums. Little is known of the nutritional value of these grains; new kinds and varieties are being grown at Fajara and Genieri,

and acceptibility trials at Genieri have shown that the villagers like some of these grains. The investigation at Fajara of nitrogen assimilation is a first step in the study of the nutritional value of tropical cereals and progress has been made in investigations of the biochemistry of certain typical native cereal products. In view of the occurrence of deficiency diseases following the application of certain orthodox milling procedures to staple cereals it was considered desirable that native preparations should be reproduced when cereal processing was mechanised. As the preparation of cereal meals and flours has been found to be the most time-consuming of all domestic tasks there can be no question that mechanised milling will have to be substituted for hand methods, and plans are almost complete for a mill which it is proposed to erect near Genieri. In this mill it will be possible to process several tropical grains by a combination of de-husking, pearling and grinding.

83. Last year's yields of groundnuts at Genieri showed large differences between land farmed by traditional methods and that which had received certain implement and fertiliser treatments. The explanation of these differences is of the greatest importance for future work on the increase of food supplies, and the problem is being studied. Signs in growing groundnut, millet and sorghum crops, suggestive of manganese deficiency, have been found to be widespread in the Gambia and plot trials have been put down at Fajara to examine the possibilities of the occurrence of manganese and other mineral deficiences in the soils, and, in relation to this, the possibilities of deficiencies of copper, zinc and boron are being examined.

Committee for Colonial Agricultural, Animal Health and Forestry Research Fifth Annual Report (1949-1950)

Ministry of Food,
Dean Bradley House,
Horseferry Road,
London, S.W.1

20th July, 1950.

SIR,

I have the honour, on behalf of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to transmit to you the Fifth Annual Report of the Committee covering the period 1st April, 1949 to 31st March, 1950.

I have the honour to be,
Sir,
Your most obedient servant,
NORMAN C. WRIGHT
(Chairman).

The Right Honourable James Griffiths, 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., Sec. R.S., Director, Royal Botanic Gardens, Kew (*Vice-Chairman*).

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, D.Sc., M.R.C.V.S., Dip. Bact., Veterinary Research Division, May and Baker, Limited.

PROFESSOR H. G. CHAMPION, C.I.E., Professor of Forestry, Oxford University.

DR. E. E. CHEESMAN, D.Sc., A.R.C.S., Senior Principal Scientific Officer, Agricultural Research Council.

MR. G. F. CLAY, C.M.G., O.B.E., M.C., Adviser to the Secretary of State on Agriculture.

SIR FRANK ENGLEDOW, C.M.G., M.A., B.Sc., F.R.S., Drapers Professor of Agriculture, Cambridge University.

DR. W. J. HALL, M.C., D.Sc., Director, Commonwealth Institute of Entomology.

PROFESSOR J. W. MUNRO, C.B.E., D.Sc., Professor of Zoology and Applied Entomology in the University of London.

SIR WILLIAM OGG, M.A., Ph.D., Director, Rothamsted Experimental Station.

MR. W. A. ROBERTSON, C.M.G., Adviser to the Secretary of State on Forestry.

MR. R. J. SIMMONS, C.B.E., M.R.C.V.S., Adviser to the Secretary of State on Animal Health.

DR. W. K. SLATER, D.Sc., F.R.I.C., Secretary, Agricultural Research Council.

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

DR. S. P. WILTSHIRE, M.A., D.Sc., Director, Commonwealth Mycological Institute.

DR. G. A. C. HERKLOTS (*Secretary*).

MR. W. S. BATES (*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.

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COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH.

FIFTH ANNUAL REPORT

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COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

FIFTH ANNUAL REPORT

I. GENERAL

In March, 1950, Dr. Norman Wright accepted the invitation of the Secretary of State to serve as Chairman of the Committee for a period of two years. For the eighteen months previous to this appointment the Vice-Chairman, Sir Edward Salisbury, had acted as Chairman of the Committee and members wish to place on record their appreciation of the most able manner in which he has presided over their meetings. Dr. W. K. Slater, Secretary of the Agricultural Research Council, accepted an invitation to become a member of the Committee.

2. During the year 1949-50 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 again been made available to them by the members of the various informal consultative panels, which include specialists in a number of fields who are not members of the Committee.

4. Dr. Herklots, Secretary of the Committee, spent a considerable part of the year touring colonial territories in order to gain first-hand information of the work which is being carried out in the field of agricultural research, and to make personal contact with the scientists who are engaged upon these problems. After attending the African Regional Scientific Conference which was held at Johannesburg in November, 1949, he spent a month in West Africa, visiting colonial Departments of Agriculture in Nigeria and the Gold Coast, the Oil Palm Research Station at Benin, the West African Cacao Research Institute at Tafo and the University Colleges at Ibadan and Achimota. In January, 1950, Dr. Herklots commenced a three months tour of the Caribbean area, in the course of which he visited Jamaica, British Honduras, Barbados, Trinidad and British Guiana. The opportunity was taken to visit Puerto Rico in order to establish personal contacts with the agricultural staff of the University and of the Federal Station at Mayaguez. A visit was also paid to the Inter-American Institute of Agricultural Sciences at Turrialba in Costa Rica and to the cacao plantations of the United Fruit Company at Zent.

5. During the year under review, leading American experts were appointed by the Economic Co-operation Administration to visit the African colonial territories and Mauritius in order to suggest means whereby assistance, provided under the European Recovery Programme, might contribute to the furtherance of research in a number of fields including agriculture. The reports of three separate missions appointed for this purpose have been studied by the Committee, who have selected from the considerable number of projects put forward, those which they recommend should be implemented without delay. The sterling expenditure incident to the appointment of the American scientists will in some cases be defrayed by grants from Colonial Development and Welfare Research funds.

II. REGIONAL AGRICULTURAL RESEARCH

(*a*) *East Africa*

The East African Agriculture and Forestry Research Organization

6. Work on the construction of the laboratories and houses for the headquarters of the East African Agriculture and Forestry Research Organization

at Muguga near Nairobi began in March, 1949. A water tank to hold 100,000 gallons and one European house were completed, and the building of thirty-seven other houses for European, Asian and African staff was well under way at the end of the year. A beginning was made on the building of the first block of laboratories and the library early in 1950 and plans have been prepared for the second block of laboratories and administration offices. The two miles of road from the main north trunk road to the laboratories is nearly completed.

7. The Amani station—the former East African Agricultural Research Institute—has been maintained and most of the scientific staff have resided and worked there. The division of administrative and accountancy work as between Amani and Nairobi, although unavoidable, has caused much delay and inconvenience. This must continue until the scientific divisions begin to move to Muguga in the second half of 1950.

8. Three specialist conferences were called during the year to plan and review research in special limited fields. They dealt with fertilizer experiments in East Africa, the utilization of water by vegetation and grassland research. Papers presented and summaries of the discussions held have been published in the *East African Agricultural Journal.*

9. A Statistical Research Section has been established and has co-operated with the Fertilizer Experiment Scheme, and with the Highland Fertilizer Scheme of the Kenya Government, and has given advice and assistance to research sections of the Organization and of the Departments of Agriculture in East Africa on the design and analysis of experiments.

10. The Plant Pathology Section has been expanded and work is being done in mycology, including a study of the canker disease of cypresses, and bacteriology in addition to the studies of groundnut virus diseases and their transmission by aphis-vectors. Field trials of a large number of cassava clones, bred for resistance to the two virus diseases mosaic and brown streak, have been continued. Much has already been done to achieve this object. Until recently cassava in East Africa has been solely a peasant crop but some interest is now being shown in its production on a plantation scale with a view to the extraction of starch for export to Britain. Selected clones are being tested for this purpose.

11. The construction of the new herbarium on a site adjacent to the Coryndon Museum in Nairobi, financed under Colonial Development and Welfare Scheme R.334, is nearing completion. In it will be housed both the Amani and the Coryndon collections.

12. The work at Zanzibar on research into the sudden death disease of the clove trees has continued ; progress has been impeded by absence of staff on leave and by the delay in appointment of an entomologist. In March, 1949, a mission visited Zanzibar to advise on methods which should be employed to check the spread of sudden death on Pemba Island. The recommendations of the Mission regarding a cutting-out campaign to isolate apparently healthy trees from sources of infection were endorsed by the Committee.

The East African Veterinary Research Organization

13. During the year under review Dr. E. G. White resigned from his appointment as Director of the Organization, and Mr. H. R. Binns was appointed Acting Director.

14. The preparation of all biological products, which had been the responsibility of the East African Veterinary Research Organization since July, 1948,

was transferred for the time being to the Kenya Department of Veterinary Services on the 16th April, 1949. The newly built production block, a small isolation block, and certain other buildings erected at Kabete were placed at the disposal of the Kenya Government and sixteen members of the Organization's staff were taken over by the Kenya Veterinary Department in order that the production of biologicals should proceed smoothly and that there should be no interruption in the supply of vaccines and sera from Kabete.

15. The Kenya Government have agreed to provide an additional area of approximately nine hundred areas in the Forest Reserve at Muguga, to be known as Muguga North, and proposals are now under consideration for the erection there for the Organization of buildings for animal diseases research and the production of biologicals on modern lines with proper isolation facilities and adequate land and accommodation for the animals.

16. Three research appointments—namely, a parasitologist, an agricultural chemist for nutritional problems and a zoologist for the study of ticks—have been made.

17. Research carried out during the year included studies on the preparation of bovine pleuro-pneumonia vaccine and on the growth of the organism in the developing hen's egg; on the use of antrycide as a prophylactic against trypanosomiasis; and on helminthiasis of stock including a study of the development and bionomics of Strongyloid larvae of domestic ruminants on local pastures. A survey was commenced to determine the incidence of bovine tuberculosis in Tanganyika. Trials have been begun on the digestibility and nutritive value of East African grasses and fodder plants.

(*b*) *WEST AFRICA*

18. Financial provision has been made for the appointment of Directors of the projected West African Agriculture and Forestry Research Organization and the West African Veterinary Research Organization, but unfortunately it has not yet proved possible to fill these important posts.

(*c*) *SOUTH EAST ASIA*

19. During the year Mr. R. J. Simmons, Adviser on Animal Health, and Dr. A. E. S. McIntosh, Deputy Director of Agriculture, Federation of Malaya, visited the territories of South East Asia in order to examine the possibility of developing agricultural research on a regional basis in that area. Their comprehensive report is being studied in consultation with the Governments concerned.

(*d*) *WEST INDIES*

20. The Imperial College of Tropical Agriculture, Trinidad, administers four Research Schemes, established in 1947 under the Colonial Development and Welfare Acts, for the British West Indies. They deal with bananas, cocoa, soils and sugar technology, the last of which was sponsored by the Colonial Products Research Council. Earlier reference has been made in the Committee's Annual Report for 1947-48. The total expenditure from the Colonial Development and Welfare Research allocation provided for under these Schemes is about £700,000, part of which is on capital account for laboratories, houses and field experimental installations and the remainder for recurrent expenditure.

21. The buildings, financed mainly under these four Schemes, are well advanced. The new Biological Laboratories, the new Sugar Laboratories and the new housing blocks are in course of erection and all should be completed by August, 1950.

Banana Research

22. The Banana Research Scheme contributes a quarter of the cost of the new Biological Laboratories and will be supplied with all necessary facilities on the completion of the building. At the Banana Breeding Station at Bodles, Jamaica, the new laboratories, offices and staff residences are now completed and in occupation. The staff provided under the Scheme is now complete, with the arrival of the Junior Cytogeneticist, Mr. K. Shepherd.

23. The work on the breeding of male parents carrying the factors for immunity to Panama Disease, has now reached the stage at which much further progress cannot be made until the projected expedition to South East Asia can take place. Breeding work on the crossing of the available male parents with Gros Michel and related varieties, both in Trinidad and at the Banana Breeding Station in Jamaica, and work on the testing of the resulting families for resistance to Panama Disease, to *Cercospora* leaf spot, and for the other necessary attributes, including ripening and storage behaviour under refrigerated conditions, is progressing actively. Work is also being carried out on the conditions affecting the fertility of Gros Michel crosses, and the percentage germination of Musa seeds, also on the relative vigour of triploids and tetraploids.

24. The work on the study of Panama Disease (which is administered by the Jamaica Government, but is under the scientific supervision of the Imperial College of Tropical Agriculture) has now been actively resumed with the arrival early this year of Dr. Rishbeth in replacement of Dr. Garrett, who resigned his appointment in 1948. Investigations of the Panama Disease organism, and of antibiotics thereto, are also in progress at the Colonial Microbiological Research Institute in Trinidad, under the aegis of the Colonial Products Research Council.

Cocoa Research

25. Detailed information on the progress of the work has been made public at the Cocoa Conferences arranged by the Cocoa, Chocolate and Confectionery Alliance and published in their reports.

26. The Cocoa Research Scheme contributes one-half of the cost of the new Biological Laboratories in the course of erection. Of the total scientific staff of ten provided for under this scheme, six have now been appointed and have assumed duty. A junior Plant Physiologist is likely to be appointed in the near future, leaving to be recruited a junior Plant Breeder, a Soils Chemist and an Entomologist.

27. Work is actively proceeding on the completion of testing the ICS 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. Critical investigations of the factors concerned in the rooting of cuttings are in progress. 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 establishment of seedling plants in distant countries. 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. Experiments on the effects of shade, plant density, and other climatic and environmental factors and their interactions among themselves and with soil and nutritional factors have been arranged ; studies of cacao root systems have been begun. Work on pests and diseases is devoted chiefly to the Trinidad cacao virus and to Witches Broom disease. A study of the

virus, its symptoms and effects, and of the mealybug vectors is in progress. Experiments on the control of Witches Broom disease, by both cultural and spraying methods, have been started and studies of clonal variability in resistance to the disease are being made. Investigations are being made of the fermentation process, of variability in composition of the bean, and of the roles of nitrate and ammonium ions in the nutrition of cacao. A survey of fermentation methods is commercial use has been made.

28. River Estate is now the Cacao Experiment Station of the Imperial College of Tropical Agriculture. It has been rehabilitated from the semi-abandoned condition in which it was taken over, and most of the field experiments covering the work mentioned above have been, or are being established there, in complex layouts designed in consultation with Rothamsted and other statistical authorities. It is intended to repeat some of these key experiments at Centeno on heavy soil.

Soils Research

29. Unfortunately work under this scheme has been seriously held up for lack of staff. Of the total scientific staff of seven provided for, only two junior soil surveyors have so far been appointed. These were appointed immediately after graduation in 1948, and their work so far has necessarily had to be such as enabled them to combine survey work in a limited field with training in the specialised aspects of their jobs. Soils or hydrologic surveys have been carried out in Grenada, St. Vincent, and in Trinidad at River Estate and the new Imperial College Farm. Arrangements have been made for soil surveys to be commenced in Jamaica and British Honduras in the near future.

III. INDIVIDUAL RESEARCH PROJECTS, UNDERTAKEN WITH ASSISTANCE FROM COLONIAL DEVELOPMENT AND WELFARE RESEARCH FUNDS

(*a*) *Termites*

30. One of the resolutions made at the Fifth Commonwealth Entomological Conference drew attention to the urgent need for the expansion of research work on termites, particularly in the Colonies. It was urged that one or more entomologists should be appointed to study termites in the field and to study their taxonomy in an appropriate museum.

31. The Committee considered this resolution carefully and, as a result, recommended that Mr. W. V. Harris, Senior Entomologist in the Uganda Department of Agriculture, be appointed Officer-in-Charge of Termite Research in the Colonies, with a view to studying termites in the field and to training a small number of entomologists in this specialized work, and that the first phase of the programme should be located in East Africa. The scientific direction of the work of Mr. Harris and his team will rest with the Committee and with the Commonwealth Institute of Entomology but whilst in East Africa the team will be under the Director of the East African Agriculture and Forestry Research Organization for purposes of administration and discipline.

(*b*) *Training of Ecologists*

32. There is an urgent need for trained ecologists in the Colonies and an acute shortage of men with the right outlook and the right training. Ecologists are required in particular to undertake the extensive surveys of land resources necessary for scientific land use planning.

33. The Committee recommended that Mr. C. G. Trapnell should be appointed as Officer-in-Charge of Ecological Training and that he should be

seconded from the Agricultural Department of Northern Rhodesia for this purpose. Mr. Trapnell has been engaged in ecological work for the past eighteen years with particular reference to vegetation and soil classification and mapping and to the study of land resources. His new duties will include the maintenance of liaison with training centres in this country, the establishment of personal contacts with botanists and ecologists in Africa, and the training of men in ecology and in land use survey work at a field station in Africa to be selected by him. Mr. Trapnell will work in close association with the East African Agriculture and Forestry Research Organization ; herbarium and library work will be carried out at the extension to the Coryndon Museum in Nairobi which is in process of construction.

(*c*) *Pool of Entomologists*

34. Much entomological research is needed in the Colonies and, at the same time, there is a shortage of entomologists to do this work. In addition to research of a long term nature there are numerous short term problems which require study by experts in particular branches of entomology.

35. The Committee recommended that, subject to the approval of the Executive Council of the Commonwealth Agricultural Bureaux, there should be created a pool of three entomologists on the staff of the Commonwealth Institute of Entomology to work on Colonial problems. The Executive Council accepted the proposal and a Colonial Development and Welfare Research scheme was made to give effect to it. From this pool experts will be seconded to undertake research on *ad hoc* problems in the Colonies, special attention being given to the needs of some of the smaller territories.

(*d*) *Bio-geochemistry of Aluminium*

36. Dr. E. M. Chenery, formerly engaged on soil survey work in Trinidad, has been working at Rothamsted since July, 1948, under a Colonial Development and Welfare Research grant. He has carried out over six thousand qualitative tests and nearly seven hundred quantitative analyses on flowering and non-flowering plants in order to determine in which families occur aluminium-accumulating plants. Papers have been published in the Kew Bulletin and others are in preparation. Of the few aluminium-accumulating plants which have commercial value, the tea bush is the most important and has been the subject of detailed study, in the course of which two hundred and ninety samples of leaves from Ceylon and East Africa have been analysed.

(*e*) *Veterinary Research*

37. There was no substantial change in the position of the research on *Brucella melitensis* (Malta Fever) from that reported last year, since the continuing lack of special isolation (laboratory) facilities prevented any work with virulent *Brucella melitensis* strains. In view of the development of such new antibiotics as aureomycin and chloromycetin the medical importance of *Brucella melitensis* has greatly diminished and it has therefore been decided to terminate this Colonial Development and Welfare Research Scheme.

IV. RESEARCH WORK UNDERTAKEN AS PART OF THE PROGRAMMES OF COLONIAL DEPARTMENTS OF AGRICULTURE AND DEPARTMENTS OF VETERINARY SERVICES

38. A suggestion was made by the Colonial Office that future reports of the Research Committee should include reference to research being carried out in the Colonies in addition to those financed from Colonial Development and Welfare Research funds. The Colonial Governments were advised accordingly and asked to supply any relevant information. A considerable volume of

material was received, which it was found impossible to include in full in a necessarily restricted report of this nature.. The account which follows is therefore confined to selected items illustrating the types of work that are being done.

BRITISH GUIANA

Forest Ecology

39. No flora of British Guiana has been published. All botanical data are being compiled on standard printed forms. Over eight hundred tree species have already been dealt with. A herbarium is maintained and identification secured from Kew and New York Botanic Gardens. Correlated wood specimens for study of wood anatomy are collected as a routine measure and are submitted to the Forest Products Research Laboratory, Princes Risborough, England, to the Yale School of Forestry, and to other specialist research workers.

40. Since the Oxford University Expedition undertook their detailed ecological studies in rain forests and the publication of their results, research has continued. As a consequence *The Vegetation of British Guiana—a Preliminary Review* is now in course of preparation. It will be followed by detailed studies of individual communities. A first draft of a list of the woody plants of British Guiana has been completed and in addition bulletins on *Principal Timbers* and on *Minor Forest Products* by D. B. Fanshawe.

Soil Fertility

41. Manurial research in progress aims at the solution of the phosphate problem. The use of heavy nitrogen and phosphate dressings in the presence and absence of lime, is being investigated and ammonium phosphate is being compared with superphosphate of lime to determine their relative efficiency. Investigations are also being pursued into the mechanism of phosphorus fixation and in this field inconclusive but interesting information is already being obtained on the effects of flood following on the availability of phosphorus. Investigations are being undertaken into the causes of the loss of fertility of the pegasse soils of the Colony, particularly those occurring in the North West District after a comparatively short period under continuous cropping. Mitscherlich pot experiments are giving some promising indications that it might be possible to restore the fertility of exhausted pegasse soils by means of an elaborate fertilizer programme and rotational agriculture. The reclamation of this soil type will make available large areas of land now abandoned and will materially assist in establishing peasant agriculture.

FEDERATION OF MALAYA

Fibres

42. Varietal trials of Manila hemp are being carried out and plantings made on estates under experimental conditions. A considerable collection of clonal lines of ramie has been made and one hundred and twenty established at Serdang. They vary widely in height, tillering and maturation period; it is hoped that varieties suitable for local conditions can be selected from these. Manurial experiments with ramie on different soils have not yet given encouraging results.

Forestry Research

43. The post of Chief Research Officer to the Forestry Department has been created and one of the research officers on the staff has been promoted to the post. He will be responsible for the integration of research at the Forest Research Institute at Kepong.

Rice

44. Mechanical cultivation trials have received especial consideration. Dr. E. W. Russell of Oxford and Mr. J. C. Hawkins of the National Institute of Agricultural Engineering paid a visit and as a consequence the very serious obstacles, highly costly to overcome, appertaining to the mechanical cultivation of peat soils were clearly revealed. Mechanical cultivation on clay soils has made progress. Mechanized cultivation as such is not leading to heavier yields as compared with the traditional methods except that in a certain area deep ploughing has greatly enhanced the yield of dry padi. The future of mechanization is not to be seen in the fully cultivated settled areas but in sparsely populated parts of the country where, if the problems of peat are economically insoluble, a search must be made for large enough areas of clay soils. The survey, commenced in 1947, has been continued of the varieties of padi grown in Malaya. As a consequence 365 east coast varieties are in Kelantan test stations, 396 medium and short term varieties from Pahang and the west coast in Malacca and 140 long term varieties from all areas in Krian. Comparative trials of established and recommended varieties are being made at thirty-seven padi test stations.

FIJI

45. Land was acquired in 1948 for the principal Agricultural Station at Koronivia in the wet zone and development of the station began in July of that year. The dry zone station at Sigatoka has been expanded and long term investigations have been commenced on pasture improvement, the nutrition of dairy cattle and on the selection and breeding of pigs and poultry.

Coconuts

46. An investigation of the premature nut fall of coconuts in plantations in the Solomon Islands has been made. It has been determined that the tree-ant *Oecophylla smaragdina subnitida* Emery was useful in driving out the Coreid bug, *Amblypelta cocophaga* China, which is the immediate cause of premature nut fall. The establishment of colonies of *Oecophylla* had a beneficial effect on nut production.

Rice

47. The insect pests of rice are being studied especially the role of the Delphacid, *Sogata furcifera* Horváth, in the condition known as Rice Yellows. Almost complete control of this leaf-hopper in seedling beds can be obtained by weekly spraying with suspensions or emulsions of DDT.

GOLD COAST

Cocoa (West African Cacao Research Institute)

48. The Institute came into being on the 1st April, 1944. Gold Coast Ordinance No. 1 of 1947 provided for the legal establishment of the Institute and for a statutory committee to control and administer it. The Institute is financed from funds set aside from the profits of the West African Cocoa Control Scheme and partly from money provided by the Gold Coast and Nigerian Cocoa Marketing Boards. The objectives of the Institute are to undertake research into and investigation of all matters relating to cocoa. The Institute has some nine hundred acres of land at Tafo, where the laboratories are situated, and five sub-stations totalling one hundred and twenty acres. The main lines of work are control of diseases and insect pests of cocoa, agronomical and soil fertility problems, cacao fermentation and the production of improved types of cocoa.

Forest Ecology

49. Strip enumeration surveys on a large scale are being carried out in Forest Reserves in both the Closed and Savannah Forest zones. One of the primary objects is to determine and locate the various forest types. Essential for this work is a good herbarium and valuable collections at Ibadan are constantly being augmented, duplicate material being sent to Kew and to Oxford to ensure authentic identification.

Lime Die-back Disease

50. The lime industry is concentrated north of Cape Coast and comprises about 3,000 acres of orchards. Die-back disease first became serious about 1943 and since then the annual yields of fruit have declined steadily. There are two main forms ; in the first there is die-back of one side of the tree or of the crown, and leaf size is normal ; in the second die-back is less conspicuous initially but the whole plant is stunted and the leaves dwarfed. Research has proved that a virus is responsible, that most sweet citrus is capable of carrying it and that *Aphis citricidus* Kirkaldy (*A. tavaresi* del Guercio) is one of the vectors. Whilst a method of complete control has not been found it has been shown that limes budded to rough lemon do well whilst seedlings die out rapidly.

Soil Fertility Studies

51. In 1948 a series of fifty trials were conducted to test the effects of nitrogen, phosphate, potash, lime and grass mulch on the main annual food crops. A wide range of soil and climatic conditions was covered. Phosphate and nitrogen were found to be the principal deficiences, especially in the north. In 1949 these trials were continued, and a further series of forty trials were conducted to determine the most suitable rate and time of application of nitrogen and the most suitable rate of application of phosphate. Other field trials have been laid down to investigate the usefulness of a grass resting period in various rotations with and without inorganic fertilizers. A study has been made of the relation between the carbon nitrogen ratio and the responses of crops to nitrogen fertilizers. A further study is being made of the correlation between total, organic, absorbed, and acid soluble phosphate in the soil, and the responses of crops to phosphate.

JAMAICA

52. Three major agricultural stations and three sub-stations have been established, financed from the Colony's allocation of Colonial Development and Welfare funds. Some one hundred and fifty investigations on crops and livestock are being conducted. The main lines include evolution of tropic-hardy dairy, dual purpose and beef cattle, artificial insemination of dairy cattle, the utilization of local feeding stuffs for cattle and poultry, the control of anaplasmosis and ' red-earth ' disease of cattle, on bananas and other fruits, coffee and cocoa, food oil and fibre crops, pasture management and the evaluation of fodder grasses and legumes.

Coconuts

53. In March, 1949, Dr. H. P. Hansen was appointed to investigate in Jamaica under the scientific direction of the Imperial College of Tropical Agriculture, the Unknown Disease of the coconut. A laboratory has been established in the west of the Island in the heart of the country affected by this disease and work has commenced.

MAURITIUS

Biological Control of Cordia

54. The introduced shrub *Cordia macrostachya* (Jacq.) is a serious weed in the sugar plantations and research is being carried out to find satisfactory means of its control or eradication. In 1947 a leaf-eating beetle *Physonota alutacea cannibal* Boh. was introduced and two thousand were bred and released, but this insect did not prove a success. A second beetle *Schematize cordiae* Barb. was introduced and, after laboratory tests, was released early in 1948. About twenty thousand were liberated and by January, 1949, the field population in many areas had reached such enormous proportions that further breeding was unnecessary. Many areas of *Cordia* scrub have been completely denuded of leaves and of inflorescences. It is expected that the damage inflicted on *Cordia* will increase in the coming years. The insect has shown no tendency to attack other plants except for two additional species of *Cordia*, neither of which has any economic importance.

NIGERIA

55. Much progress has been made with the use of fertilizers in peasant agriculture, particularly for groundnuts. The results of experiments conducted at Samaru and other centres confirm the earlier results, that considerable increases in yield are obtained by placement planting of superphosphate in the form of pellets. This is now being applied to African farms in the main groundnut area.

Fibres

56. Trials are being made of high fibre-yielding strains, *Hibiscus cannabinus* and also of the wild *Honckenya* (Bolo-bolo). Investigations continue into the possibilities of *Tetracarpidium* as an oil-bearing crop. A number of experiments have been laid down to test out methods of cultivation and to obtain information on yields per acre.

57. Considerable progress has been made with mechanization trials. A number of tractor units have been set up and a substantial scheme for mechanized production of rice is already in operation in Sokoto.

Oil Palm Research Station, Benin

58. The work of this Station is now well developed. In addition to the cultivation of high yielding strains resistant to disease, work on all aspects of the oil palm is included in the programme of work. There are also a number of field experiments on soil fertility which are of considerable interest to the hill rain forest area of West Africa.

Veterinary Research

59. Field experiments were conducted with rabbit-adapted rinderpest virus, particularly in regard to its suitability for hyper-susceptible cattle and its viability under Nigerian field conditions.

60. At Vom, further work has been done towards producing a satisfactory complement-fixation test for contagious pleuro-pneumonia. The chemical pathology of trypanosomiasis has been studied further, particularly in regard to liver damage.

NYASALAND

61. The new general experiment station at Lilongwe in the Central Province is being rapidly opened up and should be in full operation during 1950.

Tea

62. The Tea Experiment Station at Mlanje has been considerably expanded, and a Tea Research Officer with experience in Kenya and Ceylon has recently been appointed.

Tung

63. At the Tung Experiment Station, Cholo, work continues on the production of high yielding clones, on fertilizer experiments and, now that a Chemist has been appointed to the Station, work on oil analysis is being conducted. A new disease of tung has recently been identified and is causing some anxiety as it has already caused serious damage to some of the experimental plants at the Station.

SIERRA LEONE

Rice

64. The introduction and selection of varieties has been continued at Rokupr where there are now one hundred and fifty-seven strains under observation. They include varieties from British Guiana, Malaya, Pakistan, Portugal and Hungary. Mechanical cultivation with tractors in the Scarcies has given such encouraging results that it is now proposed to experiment with tractor ploughing in several other districts, including Bonthe and the Colony. Good results were obtained with a mechanical rice thresher at Rokupr. Investigations have continued on the retrogressive soil changes which have occurred within empoldered rice lands. Information has also been obtained on the crop producing capacity of alluvial reclaimed soils when fertilizers are used.

TANGANYIKA

Coffee

65. At the Lyamunga Coffee Research Station amongst the experiments carried out were clonal selection trials. An experiment designed to compare the growth and yield of *Coffea arabica* on multiple stems with and without interplanted bananas and with and without manure was planted with clonal material. Experiments to improve the technique of rooting softwood cuttings have been resumed after a lapse during the war and immediate post-war years.

Pasture Research

66. The research programme is for a period of five years and entails investigation into the two main vegetative zones to be found in Tanganyika, namely in :

(i) the deciduous thicket (*Acacia-Combretum-Commiphora*) characterised by the semi-arid Central Province. For this purpose a research station has been set up at Mpwapwa adjoining the Central Breeding Station and Veterinary Research Laboratory ;

(ii) the " miombo " or deciduous woodland area (*Brachystegia-Isoberlinia*) characterised by the extensive forests of the Western Province. For this purpose a research station has been established at Itumbi some twelve miles west of Tabora.

All aspects of pasture research and grassland management fall within the scope of this work. The research at Mpwapwa includes : pasture establishment—the eradication of bush thicket by hand, machinery, fire and arboricides and the establishment of perennial grasses ; pasture maintenance and improvement ; the selection and propagation of succulent fodder and silage plants ; the collection and study of herbarium material and studies of plant/soil/water relations.

Sisal

67. Increasing attention is being devoted to methods of maintaining soil fertility and the study of deficiency diseases besides the development of rotational systems of growing sisal and the mechanization of field operations. Predators of the banana weevil have been imported by air from Trinidad in an attempt to control the sisal weevil by biological means.

Veterinary Research

68. Rinderpest research has included work towards the development of a serological test for rinderpest immunity and studies of the effect of rinderpest virus in various wild game species.

UGANDA

Cotton

69. The new Cotton Research Station of the Empire Cotton Growing Corporation at Namulonge in Uganda, to the capital and recurrent costs of which a grant of over £200,000 has been made from Colonial Development and Welfare Research Funds, is being rapidly developed and will be the centre for cotton research for all cotton-growing Colonies. In addition the Corporation are undertaking cotton breeding and other cotton experimental work in Tanganyika, Nyasaland and Nigeria.

Pasture Work

70. Any sound system of arable farming must in future embrace a period when a proportion of the arable land will be resting from cultivation and it is essential to ensure that not only will land so rested regain and improve its fertility but also that it can be put to its maximum economic use in the production of livestock products. Accordingly pasture investigation work has proceeded along the following broad lines : to discover the best grass or mixture of grasses suitable for a short-term ley, to investigate the management of both seeded leys and natural regeneration from the point of view of soil fertility and the production of stock products and to improve the management of permanent grazing on uncultivable land. To date *Chloris gayana* has been chosen as the most suitable grass for temporary leys over the Protectorate generally but in the higher regions of Kigezi good results are being obtained from a mixture of *Chloris* and *Bromus marginatus*. Elsewhere attempts to establish grass mixtures have been disappointing. While it should not at present be assumed that *Chloris* will be the only suitable ley grass there is no doubt whatsoever that for a commencement it will fulfil requirements from both a grazing and soil rejuvenation aspect.

Soil Investigation

71. A systematic study of soils from the main cotton areas has been started. The results reveal a very wide range of physical properties and of nutrient content and the enquiry promises interesting and useful results. Indications have been obtained that important accumulations of nitrate nitrogen occur seasonally in soils under Uganda conditions. Work on this problem, which has an important bearing on the nitrate status of newly opened grasslands, and time of planting after the resting grass ley has been cleared and cultivated, is in progress mainly at Kawanda and Serere, the two first-order stations.

V. REPORTS OF STANDING SUB-COMMITTEES

(*a*) *Cocoa Research Sub-Committee*

72. The members of this Sub-Committee are Mr. C. G. Eastwood (Chairman), Mr. F. C. Bawden, Dr. L. E. Campbell, Dr. E. E. Cheesman, Mr. G. F. Clay, Sir Frank Engledow, Sir Geoffrey Evans, Dr. G. A. C. Herklots, Mr. W. M.

Hood, Professor J. W. Munro, Sir William Ogg, Mr. W. A. Robertson, Sir Edward Salisbury, Mr. E. E. Wells, and Dr. S. P. Wiltshire. The Sub-Committee have continued their practice of dealing with business, as far as possible, by correspondence and only one meeting has been held during the year.

73. The attention of the Sub-Committee has again been directed chiefly to the problems of disease control and rehabilitation in West Africa, and their advice has been sought on a number of technical matters arising out of the report of the International Commission on Swollen Shoot (Colonial No. 236). In putting forward their views, members again emphasized that the only possible means by which the disease might be brought under control was a rigorous application of the policy of cutting out all infected trees. The Sub-Committee, therefore, welcomed the recent announcement by the Government of the Gold Coast of their intention to re-introduce the exercise of compulsory powers in the conduct of the cutting-out campaign.

74. The reports of the Nigerian Cocoa Survey, which are circulated to the Sub-Committee, have shown that the swollen shoot disease has a greater hold in that territory than had originally been supposed. The full extent of the outbreaks has not finally been determined but it is hoped with the aid of auxiliary staff, who have already been recruited, to limit the spread of the disease and to remove all sources of infection.

75. The Sub-Committee have continued to follow with close interest the work of the West African Cacao Research Institute at Tafo in the Gold Coast and Mr. O. J. Voelcker, lately Director of the Institute, attended the meeting of the Sub-Committee held in June. Mr. John West, Principal Research Officer at the Institute since 1945, has now succeeded Mr. Voelcker as Director on the latter's appointment to be Director of Agriculture, Federation of Malaya. The Institute has added to the many subjects upon which research was already being undertaken a new programme of investigation into the use of chemical arboricides, which may prove of value in accelerating the speed at which infected trees may be destroyed. In addition, an agreement has been concluded with Messrs. Pest Control Limited, Bourn, Cambridge, whereby a team of three scientists provided by the Company are to be attached to the Institute to carry out a programme of research into the possible use of systemic insecticides in controlling the spread of the swollen shoot disease. All parties concerned have emphasized, however, that some three years at least must elapse before there can be any question of applying such control methods on a field scale.

76. Members of the Sub-Committee attended the Cocoa Conference in September convened by the Cocoa, Chocolate and Confectionery Alliance Limited, at which members of the industry and of Colonial Department of Agriculture and research institutions were present, together with many representatives of both producer and consumer interests in foreign countries. Among the chief matters discussed were world supply and demand, cocoa research, particularly in the field of disease control, and the improvement of quality both by the production and distribution of better strains and by the introduction of more satisfactory methods of fermentation. The report of the Conference has been made available to Colonial territories interested in the production of cocoa.

77. Among other matters considered by the Sub-Committee in the course of the year were the following : the improvement of facilities for the transfer and exchange of planting material within the Colonial Empire, and the provision of more adequate accommodation for intermediate quarantine ; the control of witches broom disease in Grenada ; and the organization of a collecting expedition to South and Central America.

(*b*) *Soils Sub-Committee*

78. The members of the Sub-Committee are Sir William Ogg (Chairman), Mr. G. F. Clay, Dr. E. M. Crowther, Dr. W. Davies, Dr. F. Dixey, Dr. H. Greene, Dr. G. A. C. Herklots, Mr. G. V. Jacks, Mr. C. G. T. Morison, Dr. A. Muir, Professor G. W. Robinson, Professor H. G. Sanders, Dr. A. B. Stewart, Sir Harold Tempany and Dr. F. Yates. One meeting was held during the year under review, the remainder of the Sub-Committee's business being conducted by correspondence.

79. An important development in this field has been the appointment of Dr. Herbert Greene, M.C., Ph.D., D.Sc., late of the Department of Agriculture and Forests, Government of the Anglo-Egyptian Sudan, to be Adviser on Tropical Soils at Rothamsted Experimental Station. The major part of the expenditure in connection with this appointment is being defrayed by a grant from the Colonial Development and Welfare Research funds. The Adviser will assist generally in the correlation and initiation of soil work throughout the Colonial Empire and will endeavour, in particular, to stimulate the recruitment and organize the training of officers to undertake soil research. It is hoped that, by visiting in turn each of the main geographical regions, Dr. Greene will be enabled to build up personal contacts with the majority of the scientists engaged on soil survey and research. Colonial Governments have been invited to nominate officers as correspondents with the Adviser and to supply him with up-to-date information on the work carried out by their Departments of Agriculture. Dr. Greene left this country in March to undertake a three months tour of the Colonial territories of East, Central and West Africa. He will also take the opportunity to visit research establishments in the Belgian Congo.

80. The Sub-Committee have carefully considered the proposals for soil survey and research contained in the report by the American scientists appointed by the Economic Co-operation Administration to visit the British African Colonial territories (see paragraph 5). A number of modifications were suggested in the light of information available to the Sub-Committee on work which is already in hand in tropical Africa, and the availability of British staff to work with the American scientists who might be procured under the European Recovery Programme. It was felt to be essential that adequate provision should be made for the continuance of programmes of research undertaken by these American scientists when the period of their secondment expired. A number of projects were finally recommended for implementation, and these were subsequently considered by a Special Working Party of the Overseas Territories Committee of the Organization for European Economic Co-operation and were endorsed as being of international significance.

81. The Sub-Committee have approved a proposal that a Statistician should be appointed to carry out analyses of the responses of tropical crops to fertilizers. The Statistician and ancillary staff will work at Rothamsted under the supervision of Dr. Yates. The analyses will be confined, in the first instance, to sugarcane, and a considerable amount of information on this subject has already been provided by the sugar-growing territories. It is hoped that an appointment to the post of Statistician will be made before the middle of 1950.

82. Studentships for the training of young scientists in soil research will again be offered next year. The response to the advertisement of these awards has been somewhat disappointing and it is to be hoped that more candidates will be forthcoming shortly as there is a wide variety of posts waiting to be filled by the students upon the completion of their training.

83. Members of the Sub-Committee are to attend the Fourth International Congress on Soil Science, which is to be held at Amsterdam at the end of July, 1950.

(c) *Stored Products Sub-Committee*

84. Mr. J. C. Glover has succeeded Mr. M. W. Payne as a member of this Sub-Committee. The other members are Sir John Simonsen (Chairman), Mr. G. F. Clay, Mr. W. McAuley Gracie, Mr. G. V. B. Herford, Dr. G. A. C. Herklots, Mr. J. G. Hibbert, Mr. F. W. Irving, Professor J. W. Munro, Professor H. Raistrick (alternate Mr. G. Smith) and Mr. J. J. S. Scouler. Five meetings have been held during the year.

85. The Sub-Committee have continued to keep under review the work of the West African Pest Infestation Survey. Mr. G. S. Cotterell, leader of the Survey Team, and Mr. R. W. Howe, Senior Entomologist, have attended meetings of the Sub-Committee and have given members a first-hand account of the progress of their work. The Survey was completed at the end of March and a final report is being prepared. It is already clear, however, that there is need for further research to be undertaken into problems of pest infestation of stored products, particularly cocoa, in West Africa. This work would no doubt become one of the responsibilities of the West African Agriculture and Forestry Research Organization when it is established, but in the meantime the intention is that the investigations should be carried out by an interim research unit consisting of two entomologists and two chemists who will have laboratories at Lagos and at Kano. They will work in close co-operation with the Nigerian Department of Marketing and Exports.

86. One of the most important problems upon which the Survey Team has been engaged during the last two years has been that of the infestation of stored groundnuts by a number of pests, particularly the beetle *Trogoderma granarium*. At the suggestion of the Sub-Committee the Technical Manager of the London Fumigation Company Limited was invited to visit Nigeria towards the end of 1949 in order to explore possible means of improving arrangements for the fumigation of infested nuts. It is hoped that as a result of the recommendations contained in his report, which has been examined and endorsed by the Sub-Committee, new methods may be introduced which will make it possible to fumigate *in situ* the groundnuts stored in the open in large pyramids, each of some 750 tons. This would greatly reduce the time and effort at present expended upon handling the infested nuts through fumigation chambers.

87. The report by Mr. T. A. Oxley on his survey of problems of grain storage in East and Central Africa has been published in the Colonial Research Publications series. Both in order to facilitate action upon the recommendations contained in this report and to provide a recognized channel for the exchange of information and the dissemination of advice to workers in Colonial territories, it has been decided to appoint a Colonial Liaison Officer at the Department of Scientific and Industrial Research Pest Infestation Laboratory, Slough. The majority of Colonial Governments have already nominated officers as correspondents with the Laboratory.

88. Arising out of the report by Dr. E. E. Turtle of the Infestation Control Division, Ministry of Agriculture and Fisheries, on a visit to the Argentine, the Sub-Committee have considered a suggestion that the system of underground storage of grain which has been successfully employed in that country might be adapted for use in Colonial territories. A memorandum setting out the scientific principles of the system and its method of operation has been prepared for the guidance of Colonial Governments.

89. Other matters upon which the advice of the Sub-Committee has been sought include the control of pests infesting copra, the use of fixed fumigation installation at some of the major ports in Colonial territories, and the possibility of fumigating agricultural products while in the holds of ships.

Colonial Insecticides, Fungicides and Herbicides Committee Third Annual Report (1949-1950)

Commonwealth Institute of Entomology,
British Museum (Natural History),
Cromwell Road,
London, S.W.7

23rd June, 1950.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Insecticides, Fungicides and Herbicides Committee for the year 1949 50.

I am,

Sir,

Your obedient Servant,

(Sgd.) W. J. HALL,

Chairman.

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

Membership

PROFESSOR P. A. BUXTON, C.M.G., F.R.S., Professor of Entomology at the London School of Hygiene and Tropical Medicine, *Chairman.*

PROFESSOR G. E. BLACKMAN, B.A., Department of Agriculture, University of Oxford.

DR. J. CARMICHAEL, late Colonial Veterinary Service.

DR. F. A. DENZ, M.Sc., 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. W. J. HALL, M.C., Director, Commonwealth Institute of Entomology.

DR. G. A. C. HERKLOTS, M.Sc., Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.

DR. R. LEWTHWAITE, O.B.E., D.M., B.Ch., M.R.C.S., F.R.C.P., Joint-Secretary, Colonial Medical Research Committee.

DR. HUBERT MARTIN, Department of Agriculture and Horticulture, University of Bristol.

MR. S. A. MUMFORD, M.Sc., A.R.I.C., Chemical Defence Experimental Establishment, Ministry of Supply.

PROFESSOR J. W. MUNRO, C.B.E., M.A., D.Sc., Imperial College Field Station.

MR. D. L. PEARSON, Secretary, Tsetse Fly and Trypanosomiasis Committee.

PROFESSOR SIR JOHN L. SIMONSEN, D.Sc., 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.

Secretary—LT.-COL. H. J. HOLMAN, B.Sc.

Officer-in-Charge of Research to the Committee—MR. C. B. SYMES, O.B.E.

NOTE : Dr. Hall succeeded Professor Buxton as Chairman of the Committee in April, 1950.

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.

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

THIRD ANNUAL REPORT

CONTENTS

COLONIAL INSECTICIDES, FUNGICIDES AND HERBICIDES COMMITTEE

THIRD ANNUAL REPORT

PART I. GENERAL

An account of the formation of the Committee is given in " Colonial Research, 1947–1948 " (Cmd. 7493).

2. *Terms of Reference.* Approval was given during the year to an extension of the terms of reference of the Committee to include fungicides and herbicides (including arboricides and defoliants). The new terms of reference follow the list of members in this Report. The name of the Committee was amended to the " Colonial Insecticides, Fungicides and Herbicides Committee ", in accordance with its new functions.

3. *Membership of the Committee.* Professor Sir Ian Heilbron, D.S.O., D.Sc., LL.D., F.R.S., who had been Chairman of the Committee since its inception, resigned and was succeeded in August, 1949, by Professor P. A. Buxton, C.M.G., F.R.S.

Professor G. E. Blackman, Department of Agriculture, University of Oxford, Dr. F. A. Denz, Medical Research Council, Dr. H. Martin, Department of Agriculture and Horticulture, University of Bristol and Dr. S. P. Wiltshire, Director, Commonwealth Mycological Institute, were appointed to the Committee, thus making available a greater body of experience to assist in the wider scope of the Committee's work. Major-General T. A. Young succeeded Brigadier A. E. Richmond as a member of the Committee on his appointment as Director of Hygiene at the War Office. Professor G. Macdonald resigned from the Committee owing to other heavy commitments, but remains a member of the Malaria Sub-Committee.

The Committee wish to record their appreciation of the valuable services rendered by Sir Ian Heilbron, Professor Macdonald and Brigadier Richmond during their terms of office. The Committee owe a great deal to the energy and enthusiasm of Sir Ian Heilbron, which contributed so much to the development of the work of the Committee.

4. *Meetings.* The Committee held five meetings during the period under review.

5. *Sub-Committees.* (a) The Malaria Sub-Committee was particularly active and held five meetings during the year.

(b) The Aircraft Trials Sub-Committee met on three occasions to discuss the progress of the experiments being carried out in Tanganyika with the dissemination of DDT and BHC smokes and sprays against tsetse flies. At the third meeting in February, 1950, Mr. K. S. Hocking and Mr. Yeo were present and a programme for a second series of experiments to begin in May, 1950, for one year, was discussed in detail.

(c) Two new Sub-Committees were appointed, one to consider problems relating to herbicides and arboricides (including defoliants) and the other to deal with fungicides. The membership of these new Sub-Committees is as follows :—

Herbicides and Arboricides Sub-Committee

Dr. G. A. C. Herklots, Colonial Office (*Chairman*).
Professor G. E. Blackman, University of Oxford.
Mr. G. F. Clay, Colonial Office.
Dr. R. A. E. Galley, Agricultural Research Council.
Mr. W. A. Robertson, Colonial Office.
Mr. C. B. Symes, Officer-in-Charge of Research.
Dr. E. K. Woodford, University of Oxford.
Lt.-Col. H. J. Holman, Colonial Office (*Secretary*).

Fungicides Sub-Committee

Dr. S. P. Wiltshire, Commonwealth Mycological Institute (*Chairman*).
Mr. G. F. Clay, Colonial Office.
Dr. R. A. E. Galley, Agricultural Research Council.
Dr. G. A. C. Herklots, Colonial Office.
Mr. R. Leach, School of Agriculture, Cambridge.
Dr. H. Martin, University of Bristol.
Dr. G. Watts Padwick, Imperial Chemical Industries, Ltd.
Mr. E. F. Posnette, East Malling Research Station.
Mr. G. Samuel, Agricultural Research Council.
Mr. C. B. Symes, Officer-in-Charge of Research.
Lt.-Col. H. J. Holman, Colonial Office (*Secretary*).

PART II. SUMMARY OF ACTIVITIES

6. *Colonial Insecticides Research Team, Porton.* It is gratifying to be able to record that considerable progress has been made by the team of two entomologists and one chemist working at Porton, near Salisbury, and this is summarised later in paragraphs 26-48. The results obtained are of important practical significance and should lead to the production of more effective and economical insecticide formulations.

7. *Colonial Insecticides Research Unit, East Africa.* A great deal of the time of the staff during the year has been devoted to aircraft experiments against tsetse flies. Much remains to be done in order to determine whether the dissemination of insecticides against tsetse from the air can be made both effective and economic, and it would be quite wrong at this stage to draw any conclusions regarding either effectiveness or costs. Some of the results so far obtained are promising and fully justify the continuation of the experiments for a further year. The second series will comprise trials with improved equipment for a thousand flying hours over a period of one year. These should begin towards the end of June, 1950. The results of the first series of experiments are given in paragraphs 50-56 of this report. Mr. Hocking, the Officer-in-Charge of the Colonial Insecticides Research Unit, and Mr. Yeo, Physicist, returned to the United Kingdom at the conclusion of the first series of experiments to consult with the Committee. During the course of the first series it was realised that very much had to be learned about the movement of air and the micro-climate beneath bush canopy, and a number of discussions were held, including talks with meteorological experts, and a programme of experiments was drawn up in order to gain more knowledge of the climatic conditions existing in tsetse bush. Special equipment is being sent to East Africa and a start has already been made in collecting further data. A detailed report of the first series of experiments is in course of preparation. The Committee wish to record their thanks to the scientific staff of the Chemical Defence Experimental Establishment at Porton, who undertook the design of the new equipment, and also to the staff of Messrs. Airwork Ltd., the contracting company operating the aircraft in East Africa.

Field experiments on malaria control at Kasanji and Mbale in Uganda have been continued and results to date are recorded in paragraphs 58 and 59. Dr. P. C. C. Garnham, a member of the Committee, is visiting East Africa in May and June to assess the experiments.

8. *Fundamental Research on Insecticides.* Arrangements have been made with the Imperial College of Science and Technology and Agricultural Research Council for fundamental research on insecticides to be conducted at the Imperial College Field Station, Silwood Park and at Rothamsted Experimental Station, under the direction of Professor J. W. Munro and Dr. C. Potter respectively. At Silwood Park, a young scientist has been appointed and work has now started on techniques directed to the study of the optimum lethal size of insecticide particles and their density in air for tsetse flies in flight and at rest. Preliminary observations are also being made on the influence of tarsal structure on the toxicities of insecticidal films. At the Rothamsted Experimental Station no appointment has yet been made, but it is hoped that a Chemist will be secured shortly. In the meantime, a member of the Rothamsted staff has begun studies on the possible effect of the waxy layers on the surface of leaves on the toxicity of the deposit of chemical applied.

9. *Study Groups on Special Subjects.* The Officer-in-Charge of Research has attended discussions by specialists on dusts and the behaviour of dust clouds, and on the standardisation of techniques for the testing of aerosols. These groups have been organised by Dr. R. A. E. Galley, of the Interdepartmental Insecticides Committee.

10. *New Insecticides.* The need for preliminary studies of new insecticides, the results of which would indicate to interested bodies the desirability or otherwise of devoting a greater effort to their investigation, has been recognised for a long time. With the shortage of scientists and facilities it is not possible to create a special organisation to deal with this question, however, and no existing organisation is able to undertake the large amount of work involved.

Two informal meetings have been held at the London School of Hygiene and Tropical Medicine of representatives of the Committee, the Colonial Insecticides Research Team at Porton, the Agricultural Research Council, Rothamsted Experimental Station, Long Ashton Research Station, the Agricultural Research Council Insect Physiology Unit, the Pest Infestation Laboratory, the Imperial College of Science and Technology and the London School of Hygiene and Tropical Medicine. At these meetings the newer insecticides were reviewed, and it was agreed that preliminary work was desirable on Toxaphene, Chlordan, Compound 118, Compound 497, Methoxychlor, Heptachlor, Trichlorocamphene, Allyl Cinerin I and synergists. It was also agreed that these preliminary studies should include assessment of (i) initial insecticide power, (ii) persistence by the use of deposits from acetone solutions on filter papers, with standardisation of the papers, and of times of exposure to different rates of deposit. Test insects suggested were mosquitoes (anophelines and culicines) houseflies, bed bugs, ticks (and mites), cockroaches, stored products beetles and if possible adult fleas. Professor Buxton and Dr. Busvine undertook to conduct tests on bed bugs, ticks and perhaps mites; Dr. Hadaway (Porton) on *Aedes aegypti* and *Anopheles stephensi*; Dr. Martin (Long Ashton) proposed to continue tests with *Calandra* and locusts, Dr. Parkin (Pest Infestation Laboratory) with *Tribolium* and perhaps houseflies; and Dr. Page (Imperial College) considered that he might be able to conduct film tests with synthetic pyrethrum analogues.

Results of work already done and to be done will be made available in the Insecticide Abstracts circulated to official departments and organisations by the Interdepartmental Insecticides Committee of the Agricultural Research Council.

11. *Proposal to Establish a West African Insecticide Research Unit with the aid of funds made available through the U.S. Economic Co-operation Administration.* During the months of May, June and July, 1949, Mr. H. H. Stage, Assistant Chief of the Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, was assigned by the U.S. Economic Co-operation Administration to visit the United Kingdom and thereafter East and Central Africa, in order by personal contact and observation to ascertain and report on means whereby American assistance under the European Recovery Programme might best be made available in certain fields of Colonial Research in the areas which he visited. In his report Mr. Stage made a number of recommendations, which were considered by the Committee. Among these were two proposals, (i) for conducting research on the application of insecticides to crops in East Africa and on the development of spraying and dusting machinery for the purpose, and (ii) for establishing an insecticides team in West Africa. The Committee has recommended that these two proposals should be combined as a project for the establishment of a Colonial Insecticides Research Unit in West Africa, to conduct research on the application of insecticides to agricultural crops. The question of finding a suitable location for the Unit is being explored.

12. *Cotton Pests.* Cotton is an important peasant crop in East Africa but unfortunately suffers from several particularly destructive pests which in some years cause serious reduction of the crop. The Empire Cotton Growing Corporation has for a long time been fully aware of the need for an extensive study of the application of insecticides to cotton, and discussions have taken place with the officers of the Committee regarding the possibility of setting up a team to study the problem. The question has also been explored with Dr. B. A. Keen, F.R.S., the Director of the East African Agriculture and Forestry Research Organisation. Until recently shortage of staff has prevented a start being made, but the East African Agriculture and Forestry Research Organisation has now recruited a junior scientific officer who will begin work in the Corporation Research Station in Uganda. A more senior worker will join him as soon as one can be obtained. It has been arranged that the Colonial Insecticides Research Unit in East Africa should give advice and help as required, particularly on such questions as insecticide formulations.

13. *Research on Insecticides against Mosquitoes at the University College, Ibadan, Nigeria.* The Committee supported proposals by Dr. Kenneth Mellanby, Principal of the University College, Ibadan, Nigeria, for a programme of investigations on certain fundamental problems on the use of insecticides against mosquitoes, to be conducted at the College. Funds have been provided for a small staff and the work, in which Dr. Mellanby himself will take an active part, has now been started.

14. *Behaviour of Mosquitoes in Huts treated with DDT and BHC.* The need for ascertaining the relative effect of DDT and BHC on the behaviour of mosquitoes in huts was explained in the last report* (paragraph 12). Mr. G. Davidson has now been appointed to study the problem and has started his investigation in East Africa. Preliminary results should be available in a few months time.

15. *Malaria Control in Mauritius.* The first two sprayings of houses throughout the island have resulted in marked reductions in mosquito populations, spleen and parasite rates and the death rate. The results will have to be closely analysed before exact conclusions can be drawn, and Dr. P. C. C. Garnham, a member of the Committee, is visiting Mauritius in April and May to study the experiment critically.

* Cmd. 7739.

16. *Malaria Control in Malaya.* In the last report it was recorded that the Committee had supported a proposal for a series of experiments to determine the effect on the incidence of malaria of a number of different treatments in four similar isolated areas in South Negri Sembilan. The experiments, which are being conducted under the direction of the Institute of Medical Research, Kuala Lumpur, Malaya, have recently been started and a summary of the results so far obtained is given in paragraph 66.

17. *Attractants and Repellents for Tsetse Flies.* The question of the need for research on attractants and repellents for tsetse flies was fully discussed on a number of occasions by the Committee and the views of workers in East Africa were obtained. It is difficult to say to what extent such materials, if developed, would be of value in the control of tsetse flies, but steps are being taken to endeavour to interest workers in the Universities in the United Kingdom in the problem.

18. *Defoliation of Bush for Tsetse Control.* It has been considered that if it were possible to defoliate partially the bush in tsetse concentration areas during certain periods of the year, this might assist in the control of the fly, by making its habitat untenable. Following a number of small trials in Kenya from the ground with various compounds having phytotoxic effect, strips of bush on an island in Lake Victoria were sprayed from the air with 2, 4-D and 2, 4, 5-T at the rate of 2-4 lbs. in 3 gallons of oil per acre. From air observations the foliage of the top canopy appears to have been killed. The extent of the damage and the speed of recovery of the bush has not yet been accurately assessed, but it seems that in this instance there was very little, if any, penetration.

19. *Disinfestation of Trains against Tsetse.* This problem was considered by the Committee soon after it was formed in 1947, and the trials undertaken by the East African Tsetse Reclamation Department have been followed with interest. It was reported in the last Annual Report* (paragraph 17) that trials using a Todd Insecticidal Fog Applicator (TIFA) loaned by the Committee to the Department, had given promising results. The Kenya Railway Administration have now agreed to the construction of a short tunnel—about two-thirds of the length of a single coach—at Kiboko Station, for the purpose of de-flying trains. This is being built within the limits of the home signals, where trains will be travelling very slowly. TIFA machines will be used and if the trials are successful the manual de-flying of trains at Emali and Sultan Hamud will be discontinued.

20. *Control of Simulium.* At the request of the Uganda Electricity Board a treatment with exhaust DDT insecticide aerosol from aircraft was carried out around the camp area near the dam at Jinja, Kenya. It must be emphasised that this was purely an empirical trial and in no way an accurately controlled experiment. No simulium were caught immediately after application, but numbers built up rapidly and after three days were back to normal.

21. *Fungicides.* The Fungicides Sub-Committee met for the first time in December, 1949. The Sub-Committee recommended that the Agricultural Research Council should be informed of the interest of the Colonial Office in the further development of fundamental research on fungicides, as it felt that the work may have considerable value for the Colonial territories, as well as at home. It also recommended that the Council be asked whether it would be prepared to extend its programme of research on fungicides to include work

* Cmd. 7739.

having a specific bearing on Colonial problems. The Agricultural Research Council have informed the Colonial Office that they would be willing in principle to extend their programme of fungicide research on these lines. At the request of the Sub-Committee its Chairman, Dr. S. P. Wiltshire, undertook to address a questionnaire to plant pathologists in Colonial territories, asking for information on (*a*) the major diseases in each territory, (*b*) control measures now in practice and the success so far obtained, and (*c*) diseases likely to be susceptible to control. There has been an excellent response to the questionnaire and a draft memorandum has been prepared from the information provided and is being considered by the Sub-Committee.

22. *Herbicides and Arboricides.* An agricultural Research Council Unit to study phytotoxicity problems is being established at Oxford University under the Directorship of Professor G. E. Blackman. Arrangements are being made with the Council to extend the activities of the Unit to embrace Colonial problems on the application of herbicides and arboricides. These arrangements are not yet complete but a number of problems from official departments in Colonial territories have already been referred to Professor Blackman and his staff, who have furnished valuable information and advice.

23. *Helicopter Experiments.* It is expected that a prototype of the three-rotor Cierva Air Horse Helicopter will shortly be made available by the Ministry of Supply, so that experiments may proceed at Porton on the design of spray equipment. As mentioned in last year's report* (paragraph 15), the Committee was closely associated with a series of spraying trials with a Bell Helicopter loaned by British European Airways to the Sprayers' Sub-Committee of the Inter-Departmental Research and Development Co-ordinating Committee. As much progress as possible has been made using this aircraft and the delivery to Porton is now awaited of another type of single-rotor helicopter, with which it is hoped to continue the experiments. In the meantime investigations are proceeding at the National Institute of Agricultural Engineering using helicopter blades mounted on pylons, on which it is possible to mount spray booms in any desired position relative to the rotating blade. It is hoped that useful data will be obtained in this way which will be directly applicable to the new helicopter when it becomes available.

24. *Training of Young Graduates in Insecticide Research.* During the year a number of studentships became available for young graduates to receive training in insecticide research in the United Kingdom, with a view to their taking up employment in Colonial Service. One Studentship has so far been awarded and the recipient has begun the first stage of his training under Professor J. W. Munro at the Imperial College Field Station at Silwood Park.

25. *Collaboration with Industry.* The Officer-in-Charge of Research and the Secretary have maintained very close contact with the scientific staff of industrial organisations concerned with insect control problems. The Committee wishes to record its appreciation of the whole-hearted co-operation which its officers have received. Many representatives of industrial organisations have visited the Colonial Insecticides Research Team at Porton to discuss problems of mutual interest.

* Cmd. 7739.

PART III. REVIEW OF RESEARCH WORK

Colonial Insecticides Research Team, Porton

Aqueous Suspensions of Insecticides

26. Previous work had shown that a wettable powder is a most promising type of formulation for application to the absorbent mud walls of African huts for adult mosquito control (Hadaway and Barlow, *Bull. Ent. Res.*, 1949, *40*, 323). Further studies on the properties of aqueous suspensions of insecticides were made, therefore, and are summarised below.

27. (41)* (a) *Relation between Particle or Crystal Size and Effectiveness.* Tests with four samples of commercial DDT wettable powders indicated that their effectiveness was related to the size of the DDT particles. Kills of mosquitoes exposed for short contact periods to plaster blocks treated at a dosage of 25 mgms. DDT per sq. ft. were :—

Powder	*50% mass size of DDT in microns*	*Mean percentage kill after exposure of—minutes* 0.5	1	2	4	8	16	32
A ...	13	5	40	60	95	100		
B ...	18	3	35	58	93	100		
C ...	24	3	23	35	80	100		
D ...	74				0	10	40	68

Aqueous suspensions of ground DDT crystals separated by sedimentation into 10–20, 20—40, 40–60 and 60–80 micron size ranges were prepared and an inverse relation between DDT particle size and effectiveness against mosquitoes was obtained.

Crystal size in microns	*DDT dosage mgms./sq. ft.*	*Mean percentage kill after exposure of—minutes* 0.25	0.5	1	2	4	8	16	32
10–20 ...	25	15	41	70	98				
20–40 ...	25			5	33	60	85		
40–60 ...	25				0	0	10	38	
60–80 ...	25					0	0	3	30

Plaster blocks were treated with aqueous suspensions of crystals in three different size ranges at different dosages, so that approximately the same number of crystals was present on each block. Crystals in the 10–20 micron range at a dosage of 6 mgms. per sq. ft. were more effective than both 20–40 micron crystals at a dosage of 50 mgms. per sq. ft. and 40–80 micron crystals at a dosage of 400 mgms. per sq. ft.

Differences in effectiveness are attributed to differences in the amount of insecticide " picked up " from the treated surface during the contact period and retained by the insect. Microscopical examination of the tarsi of mosquitoes and tsetse flies showed that small crystals are picked up much more readily and in greater quantities than are larger ones. Furthermore, the few large crystals that are removed from the treated surface are more easily dislodged from the insect body during cleaning and other movements than are small crystals. The tarsal structure and the stance of the insect are probably important factors in determining the amount of insecticide picked up.

* Figures in parentheses refer to the corresponding paragraphs in the 1948–49 Report (Cmd. 7739).

28. (b) *Relation between Crystal Shape and Effectiveness.* Tests with aqueous suspensions of DDT crystals of different shapes showed that crystal length alone, at least up to 60 microns, is not critical and that the shape and mass of crystals together probably influence pick-up and determine effectiveness. Fine needle crystals 60 microns in length were slightly more effective than ground crystals in the 10–20 micron range, and both were more effective than 60 × 15 micron plate crystals. The dimensions of the crystals were such that the weights of the 10–20 micron crystals and the 60 × 15 micron plates were approximately of the same order, and both were heavier than the needles.

29. (c) *Optimum Dosage of Small Size Crystals.* There was no significant increase in kills of mosquitoes exposed for a short contact period to dosages of 10–20 micron DDT crystals above 3 mgms. per sq. ft. Persistence of deposits of these crystals, however, increased as the dosage increased above 3 mgms. per sq. ft. Each batch of mosquitoes exposed to a treated block removed a proportion of the crystals and the number of batches of mosquitoes required to deplete the surface of crystals increased as the dosage increased.

30. (d) *Particle Size and Effectiveness in Insecticides other than DDT.* The inverse relation between particle size and effectiveness is not peculiar to DDT, for it also occurred for ground crystals of methoxychlor and DDD. Particle size also influenced the effectiveness of Compound 497 and of the gamma isomer of benzene hexachloride, but to a lesser extent than it did that of DDT. The last two compounds are intrinsically more toxic than DDT to mosquitoes and the pick-up of only a few crystals of these compounds may be lethal. Particle size is of further interest in the case of gamma-BHC, for loss by vaporisation results in a reduction in particle size. The smallest particles lose toxicity rapidly and it may be necessary to include a range of particle sizes of gamma-BHC to attain maximum efficiency for both initial and residual toxicity.

31. (42) (e) *Effect of the Presence of Inert Ingredients.* The presence of an inert ingredient in aqueous suspensions of DDT crystals caused a loss in effectiveness of the insecticide, and this masking effect was intensified as the proportion of inert material to insecticide increased. Results obtained with aqueous suspensions of mixtures of 20–40 micron DDT crystals and speswhite kaolin illustrate this effect :—

Dosage in mgms. per sq. ft.		*Mean percentage kill after exposure of—minutes*				
DDT	*Speswhite*	*1*	*2*	*4*	*8*	*16*
50	0	15	65	93	100	
50	50	13	45	58	93	
50	150		15	20	48	95
50	950		3	8	18	55
0	50					0

Similarly, at the same dosage of DDT, deposits from an aqueous suspension of a 50 per cent. commercial wettable powder were more effective than those from aqueous suspensions of powders containing lower percentages of DDT.

Variation in the degree of masking of the insecticide by different diluents (diatomite, china clay, slate dust and talc) occurred but was not great, and differences in effectiveness produced by these diluents were small in comparison with those due to particle size of the insecticide.

Improvement in DDT wettable powders can be achieved, therefore, by limiting and reducing the size of the DDT particles to 10-20 microns and by the inclusion of a minimum amount of inert diluent.

32. (f) *Nature of Surface to which Insecticide is Applied.* The effectiveness of the deposit from an aqueous suspension of DDT crystals depended largely

on the nature of the surface to which it was applied. For instance, when the suspension is applied to mud or plaster the wetting agent solution is absorbed and the insecticide particles are readily available for pick-up on the surface. The same crystals are less effective on glass and other non-absorbent surfaces because the wetting agent solution remains with the insecticide particles and, on drying, causes them to adhere strongly to the surface.

33. (g) *Crystals grown on Surfaces from Solvents.* The inverse relation between crystal size and effectiveness is not necessarily true for crystals grown on surfaces from solvents. The orientation of such crystals in relation to the plane of the surface is of importance. Long needles projecting from the surface may possibly be broken into small pieces by insects and be more toxic than small crystals lying flat on and adhering to the surface. Investigations into crystal formation from solutions on different surfaces are in progress, and are described below.

The Formation and Properties of DDT Crystals

34. (a) *Precipitation of Crystals from Water Miscible Solvents.* One method of preparing insecticides in different sizes and shapes is by precipitation from water miscible solvents under controlled conditions. Important conditions with DDT are the rate of mixing and the concentrations of insecticide, solvent and wetting agent. For example, if DDT in alcohol is added to various mixtures of alcohol and water the rate of crystallisation greatly increases as the alcohol content increases, and the crystal shape produced changes from plates to rods to needles. On the other hand, if the aqueous solution is added to the DDT in alcohol only needles are obtained, as the alcohol is present initially in high concentration. The sizes of the various shapes depend mainly upon the concentration of DDT and the rates of mixture of the two solutions. It is difficult to obtain suspensions of these crystal types in an absolutely uniform condition, and for this reason only a few of them have been tested biologically during the course of the investigations described in the previous section.

35. (b) *Growth of DDT Deposits from Solvents applied to Various Surfaces.* Both the surface and the solvent used have marked effects upon the type of deposit formed. There is a marked loss in toxicity from kerosene solutions on glass as the oil film or droplets become dry and crystalline. On the other hand, Parkin and Green (*Bull. Ent. Res.*, 1947, *28*, 311) showed that movement of flies on a compressed wall board treated with a solution of DDT in kerosene stimulated crystallization and resulted in a marked increase in toxicity. The oil film is readily available on glass and the crystals when formed, are in the plane of the surface and adhere strongly. On fibre board the oil is absorbed into the fibres and is not readily available; but when crystallization does occur long fragile needles grow in a position projecting outwards from the fibres and are much more easily available and detachable. This mechanically induced crystallization of DDT on fibre-board yields a dense uniform mass of small needles, whereas spontaneous crystallization, which occurs very slowly on the same surface, gives isolated clumps of much larger needles. The extent of this difference seems peculiar to fibre board, as other materials tested did not show the phenomenon to anything like the same extent.

With DDT as insecticide the influence of the solvent used on fibre board has been studied. With over thirty solvents representing different types of chemical compounds the amount and nature of mechanically induced crystallization depended upon the volatility of the solvent, its solvent powers for DDT and the concentration of DDT actually used. Thus, concentrated solutions of high volatility gave micro-crystalline masses due to the rapid rate of crystallization, whereas poor solvents of high volatility gave needles. The crystals tend to become larger as the boiling point of the solvent increases.

Optimum growth occurred, in general, with concentrations of 5-10 per cent. w/v DDT, lower and higher concentrations giving less dense or no needle deposits.

36. (43) (c) *Crystallization from Plastic Materials.* Crystallization in and on the surface of plastic films has been studied with the plastics chlorinated rubber and polymethyl methacrylate. The best type of crystallization for toxic effect is that which occurs on the surface of the film i.e. ' blooming ', after mechanical stimulation, and this only happens with a relatively small range of ratios of plastic, plasticizer and insecticide. For instance, in chlorinated rubber films the ratio of DDT to plastic must not be greater than 0.5 when 20 per cent. on the weight of plastic of dibutyl phthalate is used as a plasticizer, for ' blooming ' to occur without crystallization throughout the film. With greater proportions of DDT the insecticide crystallizes in the film without ' blooming '. Using a constant ratio of DDT and plastic, lower proportions of plasticizer prevent any kind of crystallization, while higher proportions than that mentioned above cause dense crystallization inside the film. This result is rather opposite to the one expected, as dibutyl phthalate is a reasonably good solvent for DDT. With polymethyl methacylate there is a much greater tendency for blooming to occur with a wider range of DDT to plastic ratios. The optimum ratio is higher than that for chlorinated rubber, being about 5. The solubility of DDT in this plastic is probably quite different from that in chlorinated rubber. It is intended to extend these observations to other plastic materials.

37. (43) (d) *Surface Coatings.* A study has been made of the usefulness of insecticidal surface coatings. Block (Soap. May, 1948) listed a number of materials in which DDT and BHC could be incorporated. Of these materials urea-formaldehyde resin was found to be the most promising and DDT, BHC and Compounds 497 and 118 have been incorporated at 5%, 10% and 20% of the resin solids. Crystallization of DDT and 497 took place on the surface of the resin at concentrations of 20% but at the 5% and 10% concentrations no surface crystallization occurred (except to a very slight extent with DDT at 10% only). Crystallization could be induced by the mechanical stimulation of insects walking on the surface or by other means. No crystallization occurred with BHC and 118 and both these substances have high vapour pressures. It is possible therefore that these insecticides were lost too quickly by evaporation for crystals to appear. Successive crops of crystals of DDT and 497 were produced from the clear resin after the latter had been cleaned by petroleum ether. The deposits were very resistant to cleaning with water and cotton wool.

Compound 118 and BHC killed *Aedes aegypti* by fumigant action alone when gauze was interposed between the resin surface and the mosquitoes. Males and females *Aedes aegypti* were used at up to 24 hours old, at which age they are most resistant. The toxicity of the resins was much less before crystallization had taken place than after the crop of fine needle crystals had appeared, as measured by timed exposures of short duration. This was understandable as the fine needle crystals could easily be carried away on the legs of the insect. 20% DDT in resin gave the same order of kill with an exposure of 8 minutes duration as 100 mgm. per square foot of an oil-bound crystalline suspension of DDT on fibre-board. 20% BHC and Compound 497 at 20% killed all mosquitoes with exposures of 2 minutes.

38. (e) *Spontaneous Crystallization of DDT.* Saturated solutions of DDT in benzine, petroleum ether and medicinal paraffin mixed in varying proportions have lower solubilities for DDT than the three solvents individually. This allows the DDT to be thrown out of solution on impact on fibre-board from a

spray gun, with the immediate formation of crystals that are very toxic to the test insects used.

39. (f) *Crystal Suspensions.* Fine needle crystals of DDT up to 200 microns long were produced by precipitation from saturated solutions of DDT in methyl alcohol and ethyl alcohol into a solution of Teepol X in water. By evaporating the liquid a paste can be formed of these very fine crystals plus Teepol. Suspensibility of these crystals is excellent. They are reduced to 50 microns or less by passage through a spray gun, and deposits on fibre-board are highly toxic to mosquitoes, flies and flour beetles.

Drop Size, Density and Concentration of Insecticide

40. (39) Sprays of mineral oils produced by a spinning disc were used on glass plates to compare the effect of varying drop size, drop density per unit area and the concentration of toxicant. *Glossina palpalis* adults exposed singly under 2 × 1 glass tubes for 30 seconds to the deposits were killed with greater efficiency by greater density of droplets and greater concentration of DDT. Equivalent weights of DDT per unit area killed more *Glossina* when the drop size was progressively reduced from 0.5 mm. to 0.15 mm. in diameter. The effect of increasing the density of droplets per unit area was reduced with volatile solvents as soon as coalescence of the droplets was achieved, because the thin films so formed tended to crystallise to dryness. These dry films adhered strongly to the glass and so required much longer exposure times to kill *Glossina* while the liquid drops could be easily picked up by the insect tarsi. Conversely the discrete droplets of less than 0.25 mm. diameter from similar solvents tended to remain liquid indefinitely but crystallised to dryness soon after being disturbed mechanically, e.g. by insect tarsi.

The addition of 5% or 10% by volume of a high boiling oil delayed evaporation of these deposits to dryness, and maintained for long periods the high toxicity of such deposits to momentary contacts by flies and mosquitoes.

Toxicity of Compound 497, Chlordan and Toxaphene.

41. The chemical and physical properties, and the initial and residual contact toxicities of a number of insecticides have been investigated. The compound with most insecticidal activity is Compound 497. This has an initial toxicity of the same order as that of the gamma isomer of benzene hexachloride, but is more persistent. Deposits from a water suspension of a 25 per cent. commercial wettable powder sprayed on to plaster blocks at a dosage of 50 mgms. of '497' per sq. ft. have continued for 24 weeks to give 100 per cent. kills of mosquitoes (*Aedes aegypti*) exposed for 15 second contact. Similarly, a dosage of 25 mgms. per sq. ft. on fibre-board gave 100 per cent. kill of tsetse flies (*Glossina palpalis*) exposed for 30 second contact 24 weeks after application. Chlordan has a fairly high initial toxicity to mosquitoes but quickly loses its effectiveness. Toxaphene has a low initial toxicity to mosquitoes.

Fumigant Action of Insecticides

42. It has been found necessary to study the fumigant effect of insecticides on mosquitoes before proceeding with investigations into their contact repellency. The apparatus consists simply of a perspex cylinder, 3 inches long, closed at one end with perspex except for a central aperture ½ inch in diameter, and covered at the other with cotton mosquito gauze. A perspex ring of the same diameter as the cylinder and ¼ inch wide is attached to the end of the cylinder closed with gauze. Mosquitoes (*Aedes aegypti*) are blown gently into the cylinder through the small central aperture in the perspex end, and they prefer to rest on the cotton gauze. The perspex ring and cylinder are clamped

against the vertical test surface for a given period. Mosquitoes in the cylinder are therefore exposed to the vapour given off from the treated surface, yet are prevented from making direct contact with the deposit by the cotton gauze which is ¼ inch from the surface. At the end of the exposure period mosquitoes are transferred from the cylinder to clean cages and stored for 24 hours before mortality counts are made. All tests are carried out at 25°C and 70 per cent. relative humidity. Mosquitoes continued to rest on the cotton gauze even when the test surface had been treated at a high dosage with gamma-BHC, Compound 497, Compound 118, Chlordan, Toxaphene or DDT. These compounds are not repellent, therefore, under these conditions when direct contact is prevented.

When exposed to the vapour of gamma-BHC, Compound 497, Compound 118, Chlordan or Toxaphene, mosquitoes continued to rest on the gauze for some time, then became excited and finally were ' knocked down '. Kills were obtained, however, if mosquitoes were transferred to clean cages before they became excited and before knockdown occurred. Figures illustrating this are as follows :—

Insecticide and dosage	*Exposure time*	*% knockdown at end of exposure period*	*% kill after 24 hours*
100 mgms. Compound '497' per sq. ft.	1 hour	0	16
	2 hours	0	59
	3 hours	6	94
	4 hours	52	96
100 mgms. BHC per sq. ft. (13 mgms. gamma-BHC per sq. ft.)	¼ hour	0	44
	½ hour	16	91
	¾ hour	68	100

The compounds can be arranged initially in order of decreasing effectiveness as fumigants against mosquitoes, thus :—

gamma-BHC, pure Compound 118, Chlordan, pure Compound 497, Toxaphene.

Kills of mosquitoes resulting from exposure to the vapours of the different insecticides one day after their application were as follows :—

Insecticide and Dosage	*Mean percentage kill after exposure of—hours*						
	0.25	*0.5*	*0.75*	*1*	*2*	*3*	*4*
100 mgms. BHC per sq. ft.	33	81	100				
100 mgms. Compound 118 per sq. ft. ...	32	58	79	94			
100 mgms. Chlordan per sq. ft.	20	38	76	87			
100 mgms. Compound 497 per sq. ft. ...				7	43	90	96
100 mgms. Toxaphene per sq. ft. ...				0	0	6	10

Whereas the fumigant action of gamma-BHC, pure Compound 118 and Chlordan decreased appreciably during the first few weeks after application, that of pure Compound 497 did not. Tests are continuing.

Tests of TP 724 (oil bound suspension) for Tsetse Flies on Cattle.

43. In a preliminary experiment, the necks of calves were sprayed with 2½% and 5% DDT in this new formulation at a theoretical dosage of 500 mgms. per sq. ft. Tests with hair clippings against *G. palpalis* indicated that toxicity was practically nil after 8 days.

In a second experiment 5 cattle were sprayed all over with this formulation at a concentration equivalent to 2½% DDT and dosage of 2000 mgms. per sq. ft. Results were similar to those in the first experiment. There was an indication, however, that the longer and coarser hair on a Shorthorn retained the DDT a few days longer than the shorter, silkier hair of Ayrshire cattle.

Miscible Oils

44. It is intended to begin work upon the effects of the various constituents of emulsions on their effectiveness and residual action under varying environmental conditions. In preparation for this a detailed study of miscible oil formulations has been made, so that such components as solvents, emulsifiers, stabilisers and adhesives of a wide variety of types can be tested.

Analysis

45. (a) *Determination of Surface Active Agents.* Various methods of determining surface active agents have been examined in order to assess the importance of the distribution of these substances in sprays and residual deposits. Those methods depending upon transference of the indicator from one liquid phase to another were much more convenient to follow than those using a colour change. The method of Epton (*Trans. Farad. Soc.*, 1948, *44*, 226) was useful for some agents such as salts of alkyl sulphates and sulphated oils in wettable powders, and in determining the amount of adsorption of surface active materials on to various substances. That of Salton and Alexander (*Research*, 1949, *2*, 247) was easy to apply only to certain substances, particularly cationic agents with Aerosol OT.

46. (b) *Determination of DDT in Spray Deposits.* The Alessandrini determination of DDT (WHO/Mal./28) was investigated to see if it was convenient for estimations of spray deposits in field work. After some modification it was suitable for technical DDT in Kerosene solution or in a wettable powder in quantities of 50-400 microgrammes per sample. The principal change in the procedure was to ensure that the benzene extract was free from acid.

47. (c) *Estimation of Croceine Scarlet.* In order to use croceine scarlet as a tracer in air spraying trials it was necessary to estimate it in the presence of an emulsion if water was used to extract the sample papers. It was possible to do this by measuring the optical transmission before and after bleaching with sodium hypochlorite. This complicated procedure could be avoided if alcohol was used as the extracting solvent, a clear coloured solution without emulsion being obtained.

48. (d) *Compounds 497 and 118.* The insecticides Compounds 497 and 118 (Dieldrin and Aldrin) were prepared in pure condition for use in laboratory tests from commercial wettable powders and the technical products. Pure '497' had a melting point of 176-176.5°C., and '118' a melting point of 101-102°C. The sodium/isopropanol method was used for estimating them in small deposits.

Colonial Insecticide Research Unit, East Africa

Tsetse

Effect on Population of G. palpalis of an Insecticidal Treatment of Peripheral Vegetation only.

49. (49) *Field Experiment* 17. This experiment was described in the 1948-49 report. Final reduction of flies was 70-80%. Insecticide deposits on leaves appeared to be adequate (from chemical estimations) for the vegetation treated, but apparently insufficient flies made contact.

Insecticide Applications from Fixed Wing Aircraft

50. (50) These experiments in dense forest with liquid and smoke formulations were described in the last report.

51. *Liquid Formulations.* (51) DDT emulsion caused a reduction of 54% for five weeks after the last application. Flies then gradually increased until reduction was no more than about 10% four months after spraying. BHC emulsion had a temporary effect of about 40% reduction, but flies recovered in the four months after spraying to their original density.

52. *Smoke Formulations.* (56) DDT smoke in eight applications reduced flies by about 63%, whilst the BHC smoke caused a reduction of about 69%. The greater efficiency of the smoke applications is apparently due to the greater penetration in the bush of the small smoke particles and their better dispersal in the dense bush. The experiments indicated the difficulty of getting spray particles, particularly large liquid particles, past the forest canopy, and results suggest that much more must be known of atmospheric conditions above and below such canopies, and of the behaviour of particles of various sizes in such conditions, before this difficulty can be overcome.

53. *Insecticide Barrier Experiment, Tanganyika (with liquid insecticide).* (57) *Field Experiment No. 24.* This experiment, which was briefly described in the last report, was continued during the year. The bush treated was light deciduous thorn scrub (*Acacia* and *Commiphora*) with dense thicket in the ravine-like dry water courses. The solution used was made up with DDT in Shell Diesoline. Concentration, nominally 5%, varied between 4.56% and 4.77% w/v technical DDT (3.58% to 3.75% pp' DDT) owing to insoluble material in the DDT. Seven applications were made of the 8 square miles at a nominal dosage of 0.25 lbs. DDT per acre. The percentage of spray reaching the ground under trees averaged about 80%; though it is estimated that about 10% of the total area received reduced dosage, due to aircraft tracking errors. It is estimated that only 50-60% of flies (*G. swynnertoni*) were killed with each application, but, because this was not a breeding area this death rate was sufficient to reduce flies to nil after the fifth spraying. They remained at this level for about a month after the seventh application, in spite of the passage of nearly 13,000 cattle along the route during the spraying period. The cost was £100 per square mile per application.

54. *Field Experiments with Insecticidal Smoke in Light Bush.* (a) *Experiment No.* 25. A block of 6 square miles of bush containing *G. swynnertoni* and *G. morsitans* was treated eight times fortnightly with aircraft exhaust smoke produced from a 10% solution of DDT (80% pp') in Power Kerosene 80% and Furnace oil 20%. Particle sizes, previously assessed, ranged from 5 to 250 microns. Fly reduction as assessed on the weekly 20 miles of fly round, was :—

G. morsitans—from an average of 524 for 7 weeks before treatment to an average of 0.5 for the 9 weeks following the last treatment.

G. swynnertoni—from an average of 112 for the 7 weeks before treatment to 0.5 for the 9 weeks following the last treatment.

Weekly fly round catches in a control block averaged 94 before and 73 after spraying.

Costs for insecticide, solvent and flying totalled 3s. 5d. per acre per application.

55. (b) *Experiment No.* 26. A block of 9 square miles of bush containing *G. morsitans* and *G. swynnertoni* was treated with eight fortnightly applications

of BHC smoke produced from 10% solution of BHC (12% gamma) in 80% Power Kerosene and 20% Furnace Oil. The topography of this block made effective coverage difficult. Fly reduction, as assessed on the weekly 20 miles of fly round, was :—

G. morsitans—from an average of 38 for the 7 weeks before spraying to 2.5 for the 9 weeks following.

G. swynnertoni—from an average of 279 before to 24.5 after spraying.

Fly round catches in the control block dropped from an average of 94 before spraying to 73 afterwards, with a range in the last 9 weeks of 38 to 116.

Costs for insecticide, solvent and flying totalled approximately 4s. per acre per application.

56. *Insecticide Dispensing Equipment for Aircraft.* The results of these first aircraft insecticide applications suggest that considerable development of equipment is required before chemicals can be put down in the particle form most suitable for penetration of vegetation and most toxic to insects. Modifications are therefore being made to the present Porton liquid emission system to reduce particle size, involving the introduction of a pressure system with boom and changeable nozzles to give a range of particle sizes that should ensure an adequate proportion getting through a vegetation canopy and behaving as a heavy aerosol. This equipment is to be tried in a second series of field trials during the next year.

Field Trials with D.D.T. Emulsions, TP 520, TP 521 and Oil Bound Suspension TP 724, applied by hand to Vegetation against G. palpalis.

57. *Field Experiments 27 and 28.* A small island of about 25 acres with typical high bush was treated with Emulsions TP 520 and 521 at four fortnightly intervals in the manner adopted in earlier experiments (the bush was sprayed in fly concentration areas only). A similar island of about 50 acres was similarly treated with Shell TP 724 suspension. Reduction of *G. Palpalis* by the emulsions was about 78-80% and by TP 724 suspension about 70-80%. These trials were conducted by a member of the Shell scientific staff seconded for six months to the Colonial Insecticides Team in East Africa. A full report will be submitted as soon as possible.

Mosquitoes and Malaria

Field Experiments in the Treatment of Native Huts

58. (58) (a) *Kasanji (Uganda).* This experiment has been continued and houses were sprayed again in August-September, 1949, with the same formulations as before. Another malaria parasite survey was conducted in June, 1949 (before the last spraying) with the following results. Initial parasite rates are given for comparison.

	May 1946	*June* 1949
Mumyuka (5% DDT in Diesoline)	30	17.3
Musale (Ditrene (5% DDT))	35	24.1
Mutuba II (BHC 5% W.P.)	54	21.5
Mutuba III (Guesarol (5% DDT))	51	37.9
Sabagabo (5% DDT in Diesoline—roofs only)	27	18.9
Sabawali (5% BHC in Diesoline)	35	19.3
Sabadu (Control)	20.1	17.3
Busi (Control)	—	57.7

Little further reduction of malaria, if any, is now being achieved.

59. (60) (b) *Mbale (Uganda).* All houses have been sprayed with Guesarol (DDT 33% wettable powder) in January-February and in July-August, 1949. Dosages (on sample papers) varied from 18 to 606 mgms. per sq. ft., with a mean of 152 mgms. Effect on vector mosquitoes (*A. gambiae* and *A. funestus*) is shown by the average monthly catches per 10 houses over the 11 months January to November, 1949.

By hand-catching

Treated houses	*A. gambiae*	0.7
	A. funestus	0
25 untreated houses *in* the town (Control) ...	*A. gambiae*	2.0
	A. funestus	0.16
Untreated houses *outside* the town (Control)...	*A. gambiae*	9.72
	A. funestus	1.54

By Flitting

Treated houses	*A. gambiae*	3.7
	A. funestus	0.5
25 untreated houses *in* the town (Control) ...	*A. gambiae*	12.3
	A. funestus	2.73
Untreated houses *outside* the town (Control)...	*A. gambiae*	78.8
	A. funestus	21.7

Malaria parasite and spleen surveys were conducted in February, 1949, before spraying, and in July, 1949, with results as follows :—

February	*Parasite Rate*	*Spleen Rate*
Years	*African Children*	
0–1	36.4	26
1–5	49	36
5–10	15	33
	Asian Children	
0–1	4.8	17
5–10	3.5	—
July	*Africans*	
0–1	35	26
1–5	54	43
5–10	44	35
	Asians	
5–10	13.3	—

A further survey was carried out in December, 1949–January, 1950 and a third spraying was completed in February, 1950. Results of these are not yet available.

Studies on the Reaction of A. gambiae and A. funestus in Huts Treated with DDT and BHC

60. (12) (20) Observations similar to those made by Dr. Muirhead Thomson in Dar-es-Salaam were made in Uganda (see last report,* paragraph 12). Huts identical with those of Thomson, and fitted with the window traps designed by him, were used, but in addition fibre-board huts were employed for parallel observations, because it was considered that these offered a greater chance of recovering mosquitoes.

* Cmd. 3379.

For the first 16 weeks results were briefly as follows :—

(i) In a mud hut treated with Guesarol (33% DDT) wettable powder at a dosage of 145 mgms. pp' DDT per sq. ft. (estimated chemically), kills of *A. gambiae* and *A. funestus* were 62% and 78% respectively over the 16 weeks.

In a similar hut treated with BHC (P. 530) wettable powder at a dosage of 27.5 mgms. gamma BHC per sq. ft. (estimated chemically) kills of *A. gambiae* and *A. funestus* were 98% respectively.

(ii) In the fibre-board huts treated in similar fashion the kill of *A. gambiae* was 97% for both DDT and BHC, and of *A. funestus* 100% for DDT and 97% for BHC, over the 16-week period.

These figures do not confirm those of Dr. Muirhead Thomson. Recently it has been ascertained that Thomson used a Ditrene DDT wettable powder, and this has relatively larger DDT crystals than Guesarol, which would not only separate out rapidly when mixed with water but would also be much less toxic than the smaller crystals of Guesarol. It is not improbable, therefore, that Thomson's results were at least partially the product of a low DDT dosage of an unsuitable formulation. The observations are being continued.

Special Laboratory Experiments

61. The investigations conducted by the member of Shell scientific staff included comparisons of the toxicity to mosquitoes of TP 724 DDT oil bound suspensions, and two other DDT suspensions (Ditrene and Guesarol). TP 724 proved to be about twice as toxic as the other formulations when applied to dried mud.

Disinfestation of Aircraft

62. (62) The small experiment described in the report of 1948-49 has been completed. From the observations made it is concluded that the DDT carbon-tetrachloride emulsion used when applied at a dosage of 100 mgms/square foot to all internal surfaces of an aircraft in regular service remained toxic to mosquitoes (*A. aegypti*) over a period of four months. During this period three observation flights were made to observe the reaction of mosquitoes released in the aircraft during flight. Of the mosquitoes released only 3.5 remained alive throughout the flights (each of about four hours) and all these died in less than six hours after the flights.

Malaria Eradication Experiment—Mauritius

63. (76-79) The plan of this experiment for the elimination of malaria was described in the last report. Three insecticide formulations were used, each in a different zone of the island. These were 5% DDT in kerosene solution, 5% DDT wettable powder and 5% BHC wettable powder. The first spraying was completed in May, 1949, and a second was started in August and completed in January, 1950. Spleen and parasite surveys were conducted in December, 1948-January, 1949, and July-December, 1949.

64. A very large amount of data has been accumulated. This is being critically studied and it will be some time before the results can be fully assessed, and therefore no definite conclusion can yet be drawn regarding the relative efficacy of the various insecticides used. It seems, however, that *Anopheles funestus* has been virtually eliminated, but while considerably reduced numbers of *Anopheles gambiae* are found in houses, widespread breeding is still taking place.

It is stated that during the period January-May, 1950, there was very little malaria, although this period was climatically ideal for the production of severe epidemic conditions.

65. Total costs of the two applications, including salaries of scientific, supervisory staff and labour, insecticides and solvents, transport, general stores and miscellaneous expenditure chargeable to the experiment are as follows :—

	Cost in rupees per :		
	Building	Room	Inhabitant
1st Spraying :			
For population in all treated zones (324,191)	2·31	1·40	1·63
Total population (444,521)	1·9	1·13	1·19
2nd Spraying :			
For population in treated zones (180,121) ...	2·53	1·53	1·91
For total population (444,521)	1·23	0·74	0·77

Malaria Control in Malaya

Investigations with Residual DDT and BHC for Control of Mosquitoes and Malaria

66. (8) Preliminary investigations with experimental huts showed that BHC and DDT were very toxic to *A. maculatus*, and that one application of 200 mgms. of DDT (33% wettable powder) and 20 mgms. of gamma BHC (P. 530 wettable powder) killed 86% and 99% respectively of this species entering huts treated, over a period of 12 weeks after treatment. Over a period of 16 weeks DDT at 200 mgms. per sq. ft. killed 87% of all *maculatus* entering treated huts, and BHC (2– mgms. gamma) killed 98%.

Experimental spraying of houses in the Inas valley with DDT wettable powder at a dosage of 200 mgms/sq. ft. and with BHC in the Ulu Nuri valley at a dosage of 40 mgms. (gamma)/sq. ft. has progressed smoothly. The first applications were made in August, 1949. They are being repeated at three-monthly intervals. The sprayers are of the Vermorel Bucket type, fitted with a Four Oaks lance. Nozzles are being changed once a week because of the abrasive action of the powders. Deposits are checked by weight measurement and chemical estimation of sample papers. The inhabitants are much impressed by the effect of the spraying on a wide variety of domestic insects. In a third valley in this region the people are being treated experimentally with paludrine. No results of this rural experiment are yet available.

APPENDIX

List of Publications

Papers Published

Further Studies on the Loss of Insecticides by Absorption into Mud and Vegetation. By A. B. Hadaway and F. Barlow. *Bulletin of Entomological Research*, 1949, *40*, 323–343.

Bulletin of Entomological Research, 1950, *41*, 63–78.

Observations on Mosquito Behaviour in Native Huts. By A. B. Hadaway and F. Barlow.

Malaria Eradication Experiment, Mauritius—Second Progress Report, 7th November, 1949. Government Printer, Mauritius.

Papers in the Press

Bulletin of Entomological Research.

Studies on Aqueous Suspensions of Insecticides. By A. B. Hadaway and F. Barlow.

Distribution and Fate of *A. gambiae* and *A. funestus* in two different Types of Huts treated with DDT and BHC in Uganda. By P. R. Wilkinson. *Bulletin of Entomological Research.*

Reports Circulated in Mimeographed Form

Progress Report No. 1, Colonial Insecticides Research Unit, Porton.

The effects of Synthetic Insecticides on Beneficial Insects and Wild-life. A Review of Some of the Literature. By A. B. Hadaway.

Aerial Spraying Against Tsetse Flies in East Africa (Colonial Insecticide Research Unit):

I. Preliminary Experiments with Emulsions and Aerosols against *G. palpalis.*

II. Barrier Spraying with an Oil Solution of DDT.

Peripheral Vegetation Spraying, Ziribanje Island. By K. E. Woodcock, Colonial Insecticide Research Unit.

The Effects of DDT Sprayed from the Air Against Larval and Adult W. African Mosquitoes. (August–November, 1944.) *Porton Report* No. 2669.

Colonial Economic Research Committee Third Annual Report (1949-1950)

London School of Economics and Political Science,
Houghton Street,
Aldwych, W.C.2.

8th August, 1950.

SIR,

I have the honour on behalf of the Colonial Economic Research Committee to transmit to you the Third Report of the Committee covering the period from 1st April, 1949, to 31st March, 1950.

I have the honour to be,
Sir,
Your most obedient servant,
(sgd.) ARNOLD PLANT

The Right Honourable James Griffiths, M.P.,
Secretary of State for the Colonies.

COLONIAL ECONOMIC RESEARCH COMMITTEE

Membership

PROFESSOR SIR ARNOLD PLANT, Professor of Commerce, University of London (London School of Economics), *Chairman.*

PROFESSOR A. J. BROWN, Professor of Economics, University of Leeds.

MR. H. CAMPION, C.B., C.B.E., Director of Central Statistical Office, Offices of the Cabinet.

PROFESSOR S. H. FRANKEL, D.Sc. (Econ.), Professor of Colonial Economic Affairs, University of Oxford.

MR. R. GLENDAY, M.C., Federation of British Industries.

MR. R. L. HALL, C.B., Director of Economic Section, Offices of the Cabinet.

DR. J. R. RAEBURN, Reader in Agricultural Economics, University of London (London School of Economics).

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.

MR. J. STAFFORD, Head of Statistics Division, Board of Trade.

MR. C. S. ROBERTS, Secretary.

There is in addition an Advisory Panel on National Income Studies, the membership of which includes Professor Sir Arnold Plant (Chairman), Professor Brown, Professor Frankel and Professor E. A. G. Robinson, who are members of the Committee, together with Mr. E. Jackson of the Central Statistical Office, Mr. J. R. N. Stone of the Department of Applied Economics, University of Cambridge, and Mr. R. C. Tress of the London School of Economics.

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

THIRD ANNUAL REPORT

I. INTRODUCTORY

1. Owing to the pressure of other engagements which prevented their regular attendance at meetings Professor G. C. Allen and Professor W. A. Lewis resigned from the Committee towards the end of the year.

2. Miss P. Deane relinquished the Secretaryship of the Committee on leaving the Colonial Office at the end of 1949. The appointment was subsequently filled, first by Mr. R. W. Newsam and then by Mr. C. S. Roberts.

3. There were four meetings of the Committee, and one of the Advisory Panel on National Income Studies, during the year.

II. ECONOMIC RESEARCH PLANNING

4. As foreshadowed in paragraph 5 of the previous Annual Report the Committee has assisted in the preparation of a comprehensive programme of Colonial economic research and, in collaboration with the Colonial Governments, a list of priority research projects, to be undertaken as and when qualified research workers are forthcoming, has been drawn up. The subjects covered in this list include :—

(i) The national income of Nigeria.
(ii) The problems arising from the dependence of certain Colonial territories upon imported foods.
(iii) Transport economics in relation to economic development, with special reference to Nigeria.
(iv) The economics of the oil palm industries in Nigeria and Sierra Leone.
(v) The organisation of the retail trade in Tanganyika, Nyasaland and Zanzibar.
(vi) The economics of land use in Jamaica.
(vii) Fiscal policy in relation to Colonial economic development.
(viii) The national income of Mauritius.
(ix) A rural economic survey of Malaya.
(x) Capital investment in the Colonial territories.

Arrangements for research projects covering the first three of these subjects were by the end of the year well under way, while exploratory steps were being taken in connection with the others. The study of the national income of Nigeria is to be undertaken by a team of research officers working under the general supervision of the Department of Applied Economics, Cambridge. A study of the data available with regard to Colonial dependence on imported foods is being made by Dr. Leubuscher, and the enquiry into the transport economics of Nigeria by Professor Gilbert Walker of the University of Birmingham.

5. Difficulty in securing suitable research workers has continued to be one of the principal hindrances to the progress of the Colonial economic research programme. In an effort to attract suitable persons a memorandum was distributed during the year to Universities, research institutions and other similar bodies, listing the fields of research in which the Secretary of State particularly wishes to encourage investigation, and setting out the various types of grants which are available to qualified economists. Following upon this several enquiries have been received from students desiring to undertake Colonial economic research, but applications from fully trained research workers have not been as numerous as had been hoped. Efforts are also being

made to secure the co-operation of research institutions in the United Kingdom and the Colonial territories which might, with suitable financial or other assistance, be willing and able to undertake specific studies.

III. ECONOMIC RESEARCH PROJECTS IN PROGRESS

6. Dr. Leubuscher's series of papers dealing with the Location of Processing Industries for Colonial Products was completed during the year, and the papers appeared individually in the Bulletin of the Imperial Institute. It is hoped to publish them in one volume within the near future. Other economic research schemes which were in progress at the end of the year were :—

(*a*) An enquiry into Colonial monetary systems by Dr. I. Greaves. After visits to the West Indies and West Africa, Dr. Greaves has submitted two interim reports and hopes to complete her final report by the end of November, 1950.

(*b*) An enquiry into the organisation of trade in West Africa by Mr. P. T. Bauer, M.A., Fellow of Gonville and Caius College and Lecturer in Colonial Economics, University of Cambridge, the results of which are also expected to be available before the end of 1950.

IV. GENERAL

7. The Committee have continued to co-operate with the Colonial Social Science Research Council in the establishment of institutes of economic and social research attached to Colonial Universities, and in the consideration of research projects in which the two bodies have a joint interest.

8. The planning and organisation of economic research in the Colonial territories continued to be the special responsibility of the Economic General Department of the Colonial Office, of which the Secretary of the Committee is a member, and to which are attached three Research Officers and two Assistant Research Officers.

(27578) Wt. 623-5469 K24 10/50 G.S.St.

THE COLONIAL TERRITORIES, 1949-50

Cmd. 7958

CORRIGENDA

Page 1, line 4. *For* " aggression " *read* " oppression ".

Page 7, paragraph 30, line 7. *For* " that of Mr. L. S. Amery in the 1920's " *read* " that of Sir Philip Cunliffe-Lister, now Viscount Swinton, in 1931-35 ".

Page 152, Appendix IIIA. Cyprus.

Column 2. *For* " 6,350 " *read* " 4,000 ".

Column 4. *For* " 3,000 " *read* " Nil ".

Column 5. *For* " 1,600 " *read* " 2,250 ".

Column 6. *For* " 4,600 " *read* " 2,250 ".

The totals at the foot of the columns should be amended accordingly.

Page 157, Appendix V. Quantities of Sisal and other Hard Fibres, Pyrethrum, Iron Ore, Lead, Manganese, Tin and Zinc should be shown as in thousands of tons.

LONDON : HIS MAJESTY'S STATIONERY OFFICE : 1950

(69140)