COLONIAL OFFICE

COLONIAL RESEARCH

1948—49

REPORTS OF THE

Colonial Research Committee

Colonial Products Research Council

Colonial Social Science Research Council

Colonial Medical Research Committee

Committee for Colonial Agricultural, Animal Health and Forestry Research

Colonial Insecticides Committee

Colonial Economic Research Committee

Presented by the Secretary of State for the Colonies to Parliament by Command of His Majesty
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(Each Report is preceded by a full list of Contents)

Colonial Research Council Annual Report on Colonial Research (1948-1949)

The Church House,
Great Smith Street,
Westminster, S.W.1.
19th May, 1949.

SIR,

As Chairman of the Colonial Research Council, I have the honour to transmit to you the Annual Report on Colonial Research for the year 1948–49.

I have the honour to be,
Sir,
Your obedient servant,
(Sgd.) D. R. REES-WILLIAMS.

The Rt. Hon. A. Creech Jones, M.P.,
Secretary of State for the Colonies.

COLONIAL RESEARCH COUNCIL

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*DR. E. B. WORTHINGTON, M.A., Ph.D. (*Scientific 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.

* Dr. Worthington was seconded in October, 1946, for duty with the East African Governors' Conference and is at present acting as Scientific Secretary to the East Africa High Commission.

COLONIAL RESEARCH COUNCIL

ANNUAL REPORT ON COLONIAL RESEARCH FOR 1948–49

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COLONIAL RESEARCH COUNCIL
ANNUAL REPORT ON COLONIAL RESEARCH
(1948-1949)

I. GENERAL

1. In November, 1948, the Council sustained a severe loss by the sudden death of Sir John Fryer, K.B.E., F.R.S., who had been a member of the Colonial Research Committee since 1944. Shortly after the end of the year under review the Right Honourable Lord Hankey, G.C.B., G.C.M.G., G.C.V.O., F.R.S., accepted an invitation from the Secretary of State to become a member of the Council.

2. The progress recorded in the 1947-48 report* of the Colonial Research Committee in the making of Colonial Development and Welfare Research schemes continued during the year under review, 79 new schemes and 74 supplementary schemes being made. A complete list of these schemes is given in Table I of Appendix I to this report. The schemes made since 1940 now total 318, and are spread over periods ranging from a few months to ten years, the average period for major schemes being five years. It will be seen that the total sum allocated to research schemes during the year amounted to £1,652,169, which brings the total sum allocated since 1940 to nearly £6 million. From the last-mentioned figure must be deducted about 5 per cent. in respect of schemes which have been completed earlier than was expected, schemes replaced by others, etc. About 40.5 per cent. of the total allocation has been for agricultural, veterinary or forestry schemes, 13.6 per cent. for fisheries research, 10.1 per cent. for medical research, 9 per cent. for tsetse and trypanosomiasis control, 5.6 per cent. for social science schemes, 5.1 per cent. for products research, 4.8 per cent. for insecticides research and 2.6 per cent. for locust control. About 37.5 per cent. of the funds has been for schemes to benefit the East African territories, 18.5 per cent. for the West African group, 14.5 per cent. for the West Indian Colonies, British Guiana and British Honduras, 8.5 per cent. for Hong Kong and the territories in South East Asia and 3.5 per cent. for Northern Rhodesia and Nyasaland. Table II shows the allocations for research made each year from 1940 down to the 31st March, 1949. Table III shows the actual monies paid out in respect of research schemes approved under the Acts for each of the financial years since the year 1940-41. It will be seen that the sum paid out in respect of the year under review is of the order of £750,000, as against £425,760 paid out in 1947-48 and £169,388 in 1946-47. As it is virtually certain that the disbursement limit of £1 million allowed by the Acts for research schemes will be reached during the year 1949-50, proposals are being submitted to Parliament for the amendment of the Acts to enable the yearly disbursement to be increased. The marked rise in the annual payments during the last two years is an indication that the shortages of scientific personnel, labour, building materials and equipment, referred to in last year's report as delaying the progress of many schemes, are being slowly overcome.

3. Some of the major schemes made during the year relate to fisheries research, and include the establishment of a West African marine fisheries research institute, a fisheries research station in Hong Kong and an institute for research and training in fish farming on Penang Island in the Federation of Malaya. Other schemes of a regional character comprise the institution of an East African Bureau of Research in Medicine and Hygiene, and an East African Medical Survey, the acquisition and equipment of the Sir Alfred Jones Medical Research Laboratory in Sierra Leone, the preparation of a Flora of East Africa, research into the effects of antrycide injections on

* Cmd. 7493. H.M.S.O. Price 2*s*.

cattle in East Africa, and provision for the appointments of Directors of the projected West African Agriculture and Forestry Research and Veterinary Research Organisations. A scheme of much importance concerned the establishment of the Colonial Microbiological Institute in Trinidad, which was officially opened in July, 1948, by Lord Hankey, Chairman of the Colonial Products Research Council, and which should prove of the greatest value to the Colonial Empire as a whole. Other schemes of interest include assistance towards the establishment of a malaria service in Nigeria, the establishment of a rice research station at Rokupr in Sierra Leone, the establishment of a coffee research station in Kenya and the provision of post-graduate training in this country for prospective workers on fisheries and stored products research. One of the major supplementary schemes provided funds for the buildings, laboratories and equipment needed by the East African Agriculture and Forestry Research and Veterinary Research Organisations.

4. The terms of service proposed for the Colonial Research Service were notified to Colonial Governments in September, 1948, but difficulties have arisen owing to some of the Governments principally concerned being in process of making important changes in their own terms of service, and also to the prolonged consultations with Colonial Governments on proposals previously submitted for the introduction of a Colonial Superannuation Scheme, which of course has a direct bearing on the terms for the Colonial Research Service. It is therefore not possible at this stage to indicate how soon the long projected Colonial Research Service will come into being.

5. The Colonial Research Fellowship scheme was revised during the year by the Colonial Office in consultation with the Council and a memorandum explaining the terms under which the fellowships are now granted is annexed as Appendix II.

6. Besides the Research Fellowships, schemes have been made under the Colonial Development and Welfare Acts to provide preliminary training for post-graduate students in soil research, fisheries research, sociological research and research into pest infestation of stored products, prior to their undertaking two years or more field research in Colonial territories. One of these schemes relates to the employment of a small number of American sociologists.

7. During the year a new series of publications was instituted by the Colonial Office entitled "Colonial Research Publications," which is intended for reports by persons who have been engaged on research in the Colonial sphere financed from Government sources. At the close of the year the following reports had been issued in this series:

No. 1. Report on a visit to the Rubber Growing Smallholdings of Malaya, July—September, 1946, by Mr. P. T. Bauer, Reader in Agricultural Economics, University of London.

No. 2. Report on the Water Resources of the Bechuanaland Protectorate, Northern Rhodesia, the Nyasaland Protectorate, Tanganyika, Kenya, and the Uganda Protectorate, by Professor F. Debenham, O.B.E., M.A., Professor of Geography, University of Cambridge.

No. 3. African Labour Efficiency Survey, being a survey of employees of the Kenya and Uganda Railways, carried out by a team of research workers under the direction of Dr. C. H. Northcott, Fellow of the Institute of Labour Management.

8. During the year discussions have taken place with the United States Economic Co-operation Administration with a view to securing qualified American personnel to assist a number of projects, including the Colonial

geological and geodetic surveys, and medical, insecticides and tsetse and trypanosomiasis research schemes. There were also conversations with the French and Belgian authorities to discuss closer co-operation in regard to research questions of mutual interest. It was generally agreed that this could best be achieved by the scientists in the different countries making direct contact with each other.

II. FIELDS OF RESEARCH REVIEWED IN THE PRESENT REPORT OF THE COLONIAL RESEARCH COUNCIL, AND IN THE ACCOMPANYING REPORTS OF THE SPECIALIST ADVISORY BODIES

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

9. The African Studies Branch of the Colonial Office carried out further research into the contemporary history and problems of African Administration. Studies have been made of African Local Government development, African Provincial Councils, the "Member System" of central administration, the relationship of major and minor authorities, and the history of British native administration. A beginning has been made with the survey of systems of African taxation. The Branch has extended the scope of its work to include studies of the forms and conventions of African constitutions, beginning with those of the British Central African territories. Members of the Branch visited Paris in order to gain first hand knowledge of the organisation of the French Union.

10. The desirability of bringing the research activities of the Branch and its Advisory Panel into closer touch with the activities of the Colonial Social Science Research Council was under consideration at the end of the year.

11. During the year it was decided that the typescript "Digest of African Local Administration" should be replaced by a published quarterly "Journal of African Administration" in order to provide a link between research and administration and to facilitate the exchange of administrative experience between officers of the Colonial Service and between the different African territories. This periodical is produced by the African Studies Branch and receives a wide circulation among administrative and technical officers in the African territories and in the academic world both in the United Kingdom and overseas.

12. *Local Goverment.* During the year Lord Hailey was engaged in completing a report on systems of African Native administration, including the organisation of the native Courts, which will deal with conditions in all the British African territories. Brigadier E. J. Gibbons, now Commissioner of the Cameroons, and Mr. A. J. Loveridge, Judicial Adviser, Gold Coast, visited East Africa during the year and studied the systems of local administration and native courts operating there.

13. The Colonial Local Government Advisory Panel which was formed to advise on the application of English local government experience to Africa has already proved its worth. Members discussed proposals for the reorganisation of local government in the Eastern Provinces of Nigeria with Sir Bernard Carr, Chief Commissioner, and Brigadier Gibbons, and on another occasion discussed with Mr. C. Martin, Town Clerk of Lagos, the problems of urban local government in Lagos. The advice of the Panel is being increasingly sought by Colonial Governments and by their officers on leave in this country.

14. *Land Tenure.* A bibliography of published works relating to African Land Tenure has been prepared under the direction of the Colonial Office Land Tenure Advisory Panel and the African Studies Branch. This work has now been brought up-to-date and it is hoped that copies will be available shortly. Work on the similar bibliography for the Far Eastern territories continues. The Cadastral and Land Survey Office has been reopened at the Colonial Office, 15, Victoria Street, London, S.W.1, with Sir Ernest Dowson, K.B.E., and Mr. V. L. O. Sheppard, C.B.E., as joint curators. At the request of the Panel, Sir Ernest Dowson and Mr. Sheppard prepared a paper on the principles and practice of land registration. Individual members of the Land Tenure Advisory Panel gave advice on a number of specific questions of land policy and registration during the year.

15. *Native Law.* Research into African customary law in relation to marriage and kindred matters is included in the African Marriage Survey under the direction of Mr. Arthur Phillips, formerly Judicial Adviser, Kenya, and a member of the Colonial Office Native Law Advisory Panel. The African Studies Branch continued its study of problems of native courts and of recording native customary law, particular attention being given to Dutch experience in Indonesia.

B. Agriculture, Animal Health and Forestry

16. An account of the year's work will be found in the accompanying Annual Report of the Committee for Colonial Agricultural, Animal Health and Forestry Research for the year 1948-49. Particular mention may be made of the attention which is being given to soil erosion, about which an international conference was held at Goma, in the Belgian Congo, in November, 1948.

C. Anti-Locust Research

17. With the temporary disappearance of locust swarms from Africa, a considerable re-alignment in locust research and control policy is in progress. Whereas in the past all efforts had to be concentrated on direct defence of crops from the invading locust swarms, the objective now is to prevent the formation of new swarms and thus to protect the agricultural development of Africa.

18. With this end in view, regional Control Services have been, or are being, established. Each of these Services has the task of supervising and controlling the original sources (outbreak areas) of one locust species, in order to give warning of incipient outbreaks and to take immediate steps to stop them. The funds for the work are to be provided by the countries liable to be affected by the species concerned.

19. The first of such Services is the International Red Locust Control Service, which has been in existence for several years and has done valuable work in preventing Red Locust outbreaks. A Convention was signed in February, 1949, by Great Britain, Belgium, the Union of South Africa and Southern Rhodesia, establishing this Service on a permanent basis. A similar Convention between Great Britain, France and Belgium, for the control of the African Migratory Locust is under discussion. Pending the ratification of the Convention, a Provisional International Executive Committee has been set up to supervise the French organisation which is at present keeping the Migratory Locust under control. The Belgian Government and the British territories in Africa are contributing funds towards the cost of this organisation. A Desert Locust Survey has been created by the East African High Commission, with the duty of supervising the outbreak areas of the Desert Locust found in British Somaliland, Ethiopia, Eritrea and Western Arabia.

The Survey commenced its operations in the autumn of 1948, when Mr. P. R. Stephenson was appointed as its first Director, and close contact is being maintained with similar technical services for control of the Desert Locust in Egypt, Anglo-Egyptian Sudan, Pakistan and India.

20. The work of the Anti-Locust Research Centre has continued to develop and close co-operation with the regional Services in field research has been established. A field research party, consisting of Miss Z. Waloff and Dr. R. C. Rainey, has completed its observations on the effects of weather on migrations of locust swarms in Somalia and British Somaliland (Desert Locust) and in Tanganyika Territory (Red Locust), and the results are being prepared for publication. One report, on locust migrations and synoptic meteorology in the Gulf of Aden area, has already been published.

21. Fundamental research in the Locust Laboratory of the Centre, and in various University laboratories, is in progress, and several research projects are approaching completion.

22. A scheme for research on the ecology of the Moroccan locust in Cyprus, with a view to developing methods of swarm prevention, which was prepared by the Director of the Anti-Locust Research Centre following a visit to Cyprus early in 1948, is at present under consideration.

23. Apart from the three species of locusts, there are a large number of native grasshoppers in Africa which constitute a serious potential menace to mechanised crop production schemes. Preliminary steps are being taken to collect information on the species involved, their distribution and economic importance.

24. Publications of the Anti-Locust Research Centre included three *Anti-Locust Bulletins*: on the action of insecticides on locusts in flight; on the behaviour of the Desert Locust; and on aircraft spraying of Desert Locust swarms. Journal papers sponsored by the Centre dealt with locust parasites; grasshoppers of Northern Nigeria; carotenoid pigments of locusts; and the ecology of British grasshoppers.

25. The Director of the Centre, Dr. B. P. Uvarov, attended a meeting in Nairobi of the Desert Locust Survey Advisory Committee of which he is a member; plans of work for the 1949 season were discussed and general lines of research policy outlined. Dr. D. L. Gunn represented the Centre at the International Red Locust Control Service annual meeting at Salisbury, Southern Rhodesia. Dr. Uvarov also attended the VIIIth International Entomological Congress at Stockholm and read a paper on recent progress in locust research. At the Commonwealth Entomological Conference in London, papers were read by Dr. Uvarov (Locusts and grasshoppers) and Dr. Gunn (Application of insecticides from the air).

26. An extended visit to the Centre was paid by Mohamed Hussein Bey, head of the Locust Research section of the Egyptian Ministry of Agriculture, in order to discuss problems which could be investigated in their laboratories.

D. Building and Housing Research

27. As was recorded in last year's report, the Department of Scientific and Industrial Research, in consultation with the Colonial Office, appointed Mr. G. A. Atkinson to act as Colonial Liaison Officer at the Department's Building Research Station, in order to facilitate the interchange of information between the Station and Colonial territories. Mr. Atkinson took up duty on the 1st June, 1948. Colonial Governments on their side undertook to nominate officers to correspond on technical matters directly with the Colonial Liaison Officer and by the end of the year under review, forty-two correspondents had been nominated. As a means of drawing the corres-

pondents' attention to information thought to be of interest and value, a series of Colonial Building Circular letters has been started by the Liaison Officer.

28. The Building Research Station has in the past received many enquiries from Colonial Governments and others interested in Colonial building. Under the new arrangements these are increasing. Many of these enquiries contain requests for information on improved uses of local materials for building. The use of suitable earths for walling, either as pise-de-terre or in the form of pressed or rammed stabilised earth blocks, is receiving much attention, especially in Africa. Mention should be made of the studies on the suitability of West African soils for cement stabilisation which are being carried out by Mr. A. E. S. Alcock in the Laboratory of the Gold Coast Town and Country Planning Board. Interest has also been shown in improved methods of quarrying and dressing softer building stones such as limestone and coral rock. In Jamaica and elsewhere the use of gypsum as a building material is being developed. The roofing of buildings is a major problem. Galvanised iron, almost a traditional building material in many parts of the world, is scarce at the present time, and a number of requests have been received for information on alternative materials. Unfortunately, no equally cheap substitute capable of such universal application is available. A survey of alternative materials is being made, but the selection and development of suitable roofing materials other than the imported sheet materials, galvanised iron, aluminium and asbestos cement, depends very much on local conditions and calls for experimental studies on the spot.

29. Enquiries have been received from, and assistance has been given to, manufacturers and others who are interested in the behaviour, under colonial conditions, of building materials and equipment made in this country. Proposals for the export of sectional, or prefabricated, buildings, have also been referred to the Station for comment. A paper on "Prefabrication and Colonial Building" has been prepared and is being circulated by the Colonial Office to Colonial Governments. In this paper standards for house design in hot climates are discussed, and it is stressed that the import of complete prefabricated buildings should not be regarded as a solution to the problem of Colonial housing. Their use is limited to conditions where speed of erection is of greater importance than initial cost. For the general run of building reliance must be placed on the development of local resources. This may very well include the prefabrication of building parts in central workshops, using equipment and materials which may to a greater or lesser extent have to be imported.

30. At the request of the Secretary of State a survey of costs and standards of accommodation of typical buildings was recently made in each Colony. The Liaison Officer is co-operating with the Crown Agents for the Colonies in interpreting the information obtained. The survey appears to confirm the need for a review of the very varied space and functional standards now in use, in the light of experience gained from research in this country, where it is applicable, and from research so far carried out in Australia, South Africa and elsewhere on building in hot climates. It also shows the need for further local studies in the Colonies themselves. As a first step, the standards which have been adopted for low-cost housing are being reviewed. This has included a survey of Government reports and other publications on housing in Africa, West Indies and elsewhere. Fairly comprehensive bibliographies of this literature have been prepared.

31. The opportunity was taken of the presence in this country last summer of the Director of the South African National Building Research Institute and of Mr. J. W. Drysdale, of the Australian Commonwealth Experimental

Building Station, to hold an informal meeting of the Building Research Panel of the British Commonwealth Scientific Official Conference Standing Committee to discuss research on the design of buildings in hot climates. It was decided that the Commonwealth Experimental Building Station should act as the co-ordinator of this research by virtue of being an active investigator in at least one of the climates involved. Mr. Atkinson attended this meeting and is in touch with developments in Australia and elsewhere.

32. Visitors from a number of Colonies visited the Building Research Station during 1948. Among these was a party of delegates attending the Institution of Civil Engineers' Colonial Engineering Conference which was held in July. In November the Liaison Officer visited Paris and met the Officers of the French Colonial Ministry who are concerned with housing and building research in the French Colonies. Arrangements for the exchange of technical information were made. Liaison has also been established with the Belgian Colonial Ministry.

E. Demography and Census

33. Further progress has been made during the year in carrying out censuses and counts in Colonial territories, including Malta, Kenya, Uganda, Tanganyika and Zanzibar, and there now remain only a few territories where up-to-date information is not available. In some of the latter, plans have been made to hold censuses in the near future. Because of the great practical difficulties inherent in such undertakings in some Colonies, the available information is often limited to a few simple characteristics and it is becoming apparent that the best method of obtaining the more detailed information normally associated with a population census is to employ modern sampling technique. Some work has already been done in this direction and efforts are being made to encourage wider use of the method.

34. The first volume of the late Dr. R. R. Kuczynski's "Demographic Survey of the British Colonial Empire," dealing with West Africa, was published during the year by the Oxford University Press under the auspices of the Royal Institute of International Affairs. It is hoped that the second volume, which deals with the East and Central African Colonial territories and the South African High Commission territories, will be published at an early date. The cost of publication is being defrayed by grants from the Carnegie Corporation, New York and the Colonial Development and Welfare research allocation.

F. Economic

35. See the accompanying Second Annual Report of the Colonial Economic Research Committee for the year 1948-49.

G. Engineering

36. The institution by the Crown Agents for the Colonies during 1947 of an Engineering Advisory Service to offer facilities to visiting Colonial Officials who require engineering information has proved to be well justified. In addition to personal visits from technical officials of Colonial Governments, written enquiries for information have also been received.

37. The third number of the Crown Agents Review was published in September, 1948. The Review, which provides the engineering officers of Colonial Governments with information on technical questions and developments, has been well received and evidently fulfils a useful purpose. Literary contributions from Colonial sources have been received, and it is hoped that the number of these will increase.

H. Fisheries

38. Dr. C. F. Hickling, Fisheries Adviser to the Secretary of State was on tour from January, 1949 to April, 1949 in the West Indies. Visits were made to British Guiana, Trinidad, Barbados, Grenada, the Grenadines, St. Vincent, St. Lucia, Dominica, Antigua, Jamaica, the Cayman Islands, British Honduras, and the Bahamas.

39. There appear to be some possibilities in developing marine fisheries in British Guiana, Trinidad, British Honduras, the Caymans and the Bahamas. Elsewhere no great increase in the production of the sea fisheries seems likely. But there appear to be worth-while possibilities in the development of fish production by fish farming in many of the islands. Recommendations are now being drawn up, including a scheme for the establishment of a marine fisheries research station in Trinidad, to serve the Eastern Caribbean, and possibly for financial assistance to the University of the West Indies to cover the undertaking of fundamental research into the productivity of the sea in the Western Caribbean and British Honduras.

40. No progress has been made with the West African Fisheries Research Institute, since a suitable candidate has not yet been found. The vacancy is being re-advertised.

41. In East Africa, the fisheries research station at Jinja on Lake Victoria has begun work. Valuable results have already been got in studies on the Mormyrids, the elephant-snouted fish, which have a high food value. Indeed, these results point the way to a new fishery in the Lake. Beside the Director, there is now one Scientific Officer, and two more are in training to take up their duties in late 1949 or early 1950. Dr. W. E. Frost, of the Freshwater Biological Association of the United Kingdom, visited Kenya to study the fish biology of the streams and rivers of Kenya, and to advise. Her preliminary report has been received. The Kenya Government have established a River Research and Development Centre on the Upper Sagana River to study the biology of trout streams. This research station is now in operation.

42. The fisheries survey of the Gulf of Aden was ended in March, 1949. The last three months were devoted to a survey of the fisheries of the coast of British Somaliland. It is unfortunate that the Survey took place in the worst sardine fishing year in living memory, so that work was not possible on that most important single group in the Gulf. The work, however, is being continued by the Aden Government. A systematist was added to the staff of the survey, and has named some hundreds of species of fish. He is making a special study of the tunas. There appear to be good possibilities for a canning industry in the Gulf of Aden, subject to overcoming difficulties due to the backward state of the country and the lack of communications. But the results of the Vitamin A investigation have been disappointing. Shark livers rich in Vitamin A were rare, and though the tunas and kingfish had livers with a high Vitamin A content, the yield of oil from each liver is small.

43. The Mauritius-Seychelles fisheries survey has been continued under the energetic direction of Dr. Wheeler. The research vessel has covered over 15,000 miles, including the Chagos group as well as the Seychelles, the Aldabras, Cosmoledo, the Saya de Malha, Nazareth and Fortune Banks, the St. Brandon and Sudan Banks, Mauritius and Rodriguez. The survey continues to show an abundance of fish on these banks, and echo-sounder surveys have suggested corrections to the charts, especially on the Saya de Malha Bank. Several shark livers with a high Vitamin A potency have

been obtained, and a clearer picture is being got of which species are likely to be worth commercial exploitation for Vitamin A.

44. In Sarawak, the experimental powered fishing vessel has shown that there is a marked seasonal variation in the catches of fish to be taken in the offshore waters by the Danish seine. In the early months of the year, very paying quantities of fish may be caught, whereas in the latter part of the year, especially during the monsoon season, catches are light. It is therefore clear that several seasons work will be needed to assess the possibilities of modern power-fishing methods off Sarawak.

45. Colonial Development and Welfare schemes were made for the promotion of marine fisheries research in Hong Kong and for the establishment of a research and training institute in Fish Culture at Penang in Malaya. A scheme for the erection of a marine research station at Singapore has been formulated, and schemes are being prepared for a marine research station in East Africa and a freshwater station in Central Africa. The Penang scheme is of peculiar interest and importance, since the intention is that the institute shall serve the entire Colonial Empire. The artificial rearing of fish in ponds has been practised for some three thousand years in the Far East and became established in Central Europe in the middle ages. It is therefore no novelty; but so far no attempt has been made to propagate this technique of increasing fish supplies in the Colonial Empire. The yields of fish obtained by this means are far higher than those obtained in the natural fisheries; the harvesting of pond fish is independent of adverse weather conditions; fish ponds can be sited in areas remote from large natural fisheries; and the ponds themselves can be used for alternative water or land crops, and can, in fact, be regarded as a stage in the reclamation of poor land for agricultural use. To secure the propagation of this valuable technique throughout the Colonial Empire, trained instructors are necessary, and there is at present lacking any centre where such training can be given. Further, the very high yields of fish obtained by present practice could be substantially increased by research into the fundamental processes underlying pond culture. Research is also needed on the genetics of fish, with the possibility of raising domesticated strains of fish which might prove as superior to wild fish as domestic cattle are to wild cattle. Research into the physiology of breeding would enable fish culturalists to breed their own stock, whereas at present many valuable species will not breed in captivity. Factors controlling the growth of the minute plants on which the productivity of the fishponds depends would also well repay study. Finally, the results of different modifications of the technique should be studied on a scale large enough to allow of statistical analysis. This entails the establishment of a large number of ponds identical in size and construction, where up to four different treatments can be studied simultaneously, with sufficient replications to allow for all chance factors, and so produce reliable results. There is nowhere in the world, so far as is known, a fish farming institute on the scale and of the type proposed. Fish farming is a technique which may become of very great importance, and the British Colonial Empire, which has more to gain than most other countries by the improvement and propagation of fish culture, has the chance to take the lead. A suitable site has been found on Penang Island, off the West coast of Malaya. This site has the advantages of abundant pure fresh water, it is already levelled and provided with a freshwater canal, and on the same site marine fishponds can be constructed in mangrove and nipah swamp facing the sea. The site is within easy car journey of Penang city, on a main road, on electricity and drinking water mains, near an aerodrome, and near a first-class port.

46. A further Colonial Development and Welfare research scheme was made to provide funds for the training of up to four Fisheries Research Officers, for a maximum period of two years' training each, during each of the next four years.

I. Geodetic and Topographical Surveys

47. The Directorate of Colonial (Geodetic and Topographic) Surveys continued its activities, mainly in the preparation of maps of specific areas scheduled for immediate development. Work has also proceeded on the preparation of standard topographic series. The recruitment and training of staff have progressed steadily, though neither the field survey nor cartographic establishment is yet up to full strength.

48. The Royal Air Force continued air photography in East and Central Africa, until September, by which time approximately 114,800 additional square miles (Tanganyika 19,000, Northern Rhodesia 53,000, Nyasaland 27,800 and Bechuanaland 15,000) had been covered, despite less propitious weather. The Squadron then moved to West Africa, where approximately 81,000 square miles (Sierra Leone 24,200, Gold Coast 29,200 and Nigeria 27,600) were covered. The Royal Air Force have also continued air-photography in the Far East where approximately 21,600 square miles (North Borneo 6,600, Sarawak 5,500 and Malaya 9,500) have been covered.

49. Survey parties have been, and are, at work on the ground in Uganda, Kenya, Tanganyika, Nyasaland, Northern Rhodesia and Swaziland, and considerable progress has been made with the provision of control data for mapping.

50. Mapping has continued steadily and over a hundred map sheets, covering some 20,000 square miles, have been published at various scales, while work on nearly a further 150,000 square miles is in hand.

51. Compilation has also been undertaken of small scale maps of the Falkland Islands Dependencies, an area of nearly half a million square miles, and six map sheets, covering over 200,000 square miles have been published.

J. Geological Survey

52. During the year schemes were submitted by Colonial Governments and approved by the Secretary of State for the expansion of existing Colonial Geological Surveys and for the creation of new organisations where these did not already exist, and financial provision amounting to rather more than £1 million was made under the Colonial Development and Welfare Acts. This will ensure the required services in certain Colonies for periods varying from three to five years, but it is anticipated that a total of £2½ million will be needed to extend operations to the end of March, 1956, and to provide for further schemes to accelerate geological survey operations in other Colonies.

53. Progress continued to be hampered by the shortage of geologists, and it is likely to be several years before the many vacancies can be filled. The hope expressed in last year's Report that about 25 new geologists would be recruited during the year was not realised, the actual number being 18. The total strength of the overseas scientific staff in Colonial Geological Surveys increased from 59 to 73; there were a few resignations and retirements. At the end of the period under review, recruitment had only succeeded in bringing establishments up to the strength that had been authorised before the schemes for expansion had been approved. It is estimated that about 100 geologists are now needed, and, so far as can be judged, it will be impossible to fill all vacant posts from United Kingdom

and other Commonwealth sources until the year 1952. It is not possible at the present time to forecast accurately how many geologists will be needed after that date; the annual figure for Colonial Geological Surveys may be estimated tentatively as 12.

54. During the year, the Economic Co-operation Administration set up under the Marshall Aid scheme has offered to try to supply 22 geologists and three chemists to assist the Survey staff during the coming three years. If this help materialises, it will be invaluable in bridging the gap that must otherwise exist while geologists are being trained in the United Kingdom and Dominion Universities. It is hoped to recruit well-qualified geologists on three-year contracts from various European countries.

55. The Director of Colonial Geological Surveys (Dr. F. Dixey, O.B.E.) has continued to visit Universities in the United Kingdom to explain to the teaching staffs and students the many advantages of a career in this important field, which will offer not only permanent and pensionable posts with good prospects of promotion, but work that will always be interesting because of the variety of problems and of the facilities for close association with native peoples. All Universities in other Commonwealth countries having Geology Departments have been circularised regarding these vacancies, and several well-qualified geologists have been secured. The improved salary scales now in force in many Colonies have led to increasing interest in the vacancies.

56. Until a considerable expansion of staffs has taken place, little can be done to hasten the production of the basic geological maps which is the first essential step for an appraisement of Colonial mineral resources. Most of the geologists on the small staffs at present operating must be employed on routine work, covering such important matters as mining and the examination of mineral deposits, including coalfields as yet undeveloped; there is also the very pressing need for increasing water supplies in large areas of Africa at present sparsely populated, but capable of maintaining many more people if they can be provided with water adequate for domestic and agricultural needs. Other Government Departments continually require geological advice in connection with engineering problems. For these reasons, only a few geologists are at present available to give uninterrupted attention to mapping.

57. During the year under review Dr. Dixey continued his tours of Colonial territories, visiting Singapore, the Federation of Malaya, North Borneo, Sarawak, Hong Kong and Fiji to discuss with the various Administrations their schemes for geological surveys and to advise on various problems. He went to Ottawa to establish contact with the Geological Survey of Canada, and made one journey to Washington for a similar purpose, followed later by a second visit to advise on the proposed recruitment of American geologists. Dr. Dixey served on the Council of the Geological Society of London. He was elected President of the Association of African Geologists, and presided over its sessions during the period of the International Geological Congress in London. He was Chairman of the Organising Committee set up by the Standing Committee of the British Commonwealth Scientific Official Conference to arrange a specialist conference on geology and mineral resources which was held in London and attended by delegates from the British Commonwealth. He wrote a number of papers, including one at the invitation of the Secretary-General of the United Nations intended to serve as an introduction to a discussion of regional papers on the subject of increasing mineral resources by discovery at the forthcoming United Nations Scientific Conference on the Conservation and Utilisation of Resources.

58. The first of the periodic regional conferences of Geological Surveys of neighbouring territories took place in Entebbe under the Chairmanship of the Administrator of the East Africa High Commission. Considerable interest was shown in the discussion of problems common to the East African territories and the conference was regarded as having been highly successful.

59. The Imperial College of Science and Technology, London, continued to provide Colonial geologists with courses of study; the College loaned accommodation and instruments for a course of instruction in photogeology which was attended by 15 Colonial geologists, some of them newly appointed and on the eve of proceeding to their Colonies, and others being officers on leave who welcomed the opportunity of attending a refresher course.

K. Insecticides

60. See the accompanying Second Annual Report of the Colonial Insecticides Committee.

L. Medical

61. See the accompanying Fourth Annual Report of the Colonial Medical Research Committee.

M. Meteorology

62. The shortage of trained meteorologists is still acute, and no Colonial Meteorological Service has been able to undertake any new research work. In the Gold Coast it is intended to expand the network of rainfall stations in order to assist agricultural development. Radio sonde investigations have continued at Nairobi, and a Colonial Development and Welfare grant has been made to enable a radio sonde and radar wind installation to be established in Hong Kong. The use of radar devices for the detection of precipitation has been under consideration in East Africa and Malaya, but it has been difficult to obtain suitable equipment.

N. Oceanography

63. During the year plans were made for the establishment of a National Institute of Oceanography as an Admiralty responsibility, and for the taking over by this body of the work of the Discovery Committee and its scientific staff and equipment, including the two research ships "*Discovery II*" and "*William Scoresby.*"

O. Products Research

64. See the accompanying Sixth Annual Report of the Colonial Products Research Council.

P. Road Research

65. Mr. H. W. W. Pollitt, of the Road Research Laboratory, Department of Scientific and Industrial Research, who had visited Nigeria in 1946-47, paid a further visit to Nigeria and the Gold Coast towards the end of 1948. His report on both visits is being published.

66. Colonial Governments are being asked to appoint officers to act as correspondents with the Road Research Laboratory, and to state whether they are in favour of a Liaison Officer being appointed at the Laboratory, following the precedent of the appointment of the Building Research Liaison Officer.

Q. Social Science

67. See the accompanying Fifth Annual Report of the Colonial Social Science Research Council.

R. Tsetse Fly and Trypanosomiasis

68. In accordance with the recommendations made by the Brazzaville Conference, referred to in the 1947-48 report of the Colonial Research Committee, an International Scientific Committee for Trypanosomiasis Research was established with a permanent secretariat in London. Scientists from Belgium, France, Portugal, East and West Africa, Southern Rhodesia, the Union of South Africa and the United Kingdom are members of this Committee. The function of the Committee is to review the work on tsetse and trypanosomiasis problems carried out both in laboratories and in the field, to stimulate further research and to provide a regular opportunity for the discussion of particular problems arising in research in this field. At its first meeting, held in February, 1949, an opportunity was provided for an interchange of views among the scientists of the different territories and for an appreciation of the present state of research and the making of recommendations for the more urgently required projects.

69. In accordance with another recommendation of the Brazzaville Conference, the French and Belgian Governments have set up at Leopoldville (Belgian Congo) a Standing Trypanosomiasis Bureau, through which persons and organisations interested in trypanosomiasis will be able to exchange information on the progress of their work.

70. Throughout the year the London Tsetse Fly and Trypanosomiasis Committee continued to review, in close association with the Colonial Insecticides Committee, the whole field of anti-trypanosomiasis work in British Africa and to advise the Secretary of State on various measures to combat the diseases. Considerable progress was made with the establishment of the West African Institute. Buildings for laboratory and living accommodation for the staff of the Institute are being erected at Kaduna and Vom, in Northern Nigeria, and research work has already started. Plans are being drawn up for the creation of a new central headquarters for the East African Tsetse and Trypanosomiasis Research and Reclamation Organisation which now functions from temporary headquarters in Niarobi.

71. Progress is being made in the difficult task of preparing detailed maps showing the incidence of the twenty or more different species of tsetse fly. This work, which was recommended by the Brazzaville Conference in 1948, is another example of international collaboration in the trypanosomiasis field.

72. The reports on Trypanosomiasis in Eastern and Western Africa, prepared by Professors Buxton and Davey respectively, were published by His Majesty's Stationery Office during the year, as were the reports on Tsetse Flies in British West Africa and the Anchau Rural Development Scheme prepared by Dr. Nash. The four reports taken together form a valuable basis for a statement of present knowledge in this field, and it has proved possible to make a free distribution of them to those scientists and organisations particularly interested in trypanosomiasis problems.

73. At the end of 1948 a preliminary announcement was made jointly by the Colonial Office and Imperial Chemical Industries Limited of the results of field trials conducted in the Sudan and in East Africa with the drug to which reference was made at paragraph 56 of last year's report. This drug, now called "Antrycide," has proved successful in the treatment of trypanosomiasis infections in cattle, including *T. Congolense* and *T. Vivax* hitherto particularly difficult to treat by drugs. It is hoped that experiments which are now in progress will help to evaluate the prophylactic value of the drug and extend its practical application.

S. Water Pollution

74. Colonial Governments are being asked to nominate officers to act as correspondents with the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research.

T. Water Resources

75. The Report by Professor F. Debenham on the Water Resources of the Bechuanaland Protectorate, Northern Rhodesia, the Nyasaland Protectorate, Tanganyika Territory, Kenya and the Uganda Protectorate was published during the year, and brought to the attention of other Colonial Governments likely to be interested in this most important subject. A Colonial Development and Welfare scheme to survey the potentialities of the Lake Bangweulu area, based on Professor Debenham's recommendations, is being made for Northern Rhodesia.

APPENDIX I

Table I

LIST OF SCHEMES APPROVED FOR RESEARCH GRANTS UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS DURING THE PERIOD 1ST APRIL, 1948 TO 31ST MARCH, 1949

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	General:—		£
238 238A	General	Appointment for 3 years of a Colonial Liaison Officer at the Building Research Station of the Department of Scientific and Industrial Research. (This scheme supersedes the schemes R.143 and 143A made in 1946–47.)	13,900
239	do.	Research into aluminium accumulating plants by Dr. E. M. Chenery.	3,195
240	do.	Tropical and Sub-Tropical Soils Conference, June 1948, incidental expenditure.	145
241 241A 241B	do.	Various Anti-Locust Research Centres. Research projects to be undertaken during the next 3 years.	10,908
243	do.	Colonial Insecticides Committee. Salaries etc. of the research staff in the United Kingdom for the years 1948–49 to 1950–51.	12,700
247 247A	do.	British Commonwealth Scientific Office. Contributions to the maintenance of the work of the London Office during 1948–49 and 1949–50.	1,647
250	do.	Colonial Insecticides Committee. Visit of an observer to Trinidad to attend trials on the control of the froghopper pest of sugar cane.	420

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	General—*contd.*		£
47B 47C	General	Demographic Research ... ... Publication of the late Dr. Kuczynski's "Demographic Survey of the Colonial Empire" (supplementary provision).	1,005
258	do.	Study of Colonial monetary systems by Miss Ida Greaves.	1,050
261	do.	Sociological Research ... ... Expenses incurred in the interviewing in the U.S.A. of American candidates for Colonial projects.	33
264	do.	Fisheries Research ... ... Institution of post-graduate studentships for training. Grant provides for expenditure over a period of 4 years.	13,320
266	do.	Stored Products Research ... ... Institution of post-graduate studentships for training. Grant provides for expenditure over a period of 4 years.	10,080
269	do.	Visit of 3 experts to East Africa and Northern Nigeria to make a survey of the sociological, economic, agricultural and technical problems which require study in connection with the mechanization of colonial agriculture.	1,750
274	do.	Sociological research ... ... Scheme to provide for six months preliminary study in the United Kingdom for selected American sociologists prior to undertaking work in the Colonies.	2,850
279	do.	Fisheries Research ... ... Training of a scientific officer to carry out research in fish preservation and processing.	1,177
77B	do.	Investigation into the technique of parboiled rice (supplementary provision).	500
289	do.	Provision of equipment and materials for insecticides research sponsored by the Colonial Insecticides Committee during the next three years.	1,500
292	do.	Creation of post-graduate studentships to provide training for Colonial soils research during the next four years.	6,500
294	do.	Visits by Mr. V. L. O. Sheppard to study systems of land registration in various countries.	500

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	General—*contd.*		£
295	General	Research at Lister Institute of Preventive Medicine on the properties of antisera for identification of blood found in mosquitoes and other insects.	600
296	do.	Appointment of a tropical soils adviser to the Rothamsted Experimental Station for five years. (This scheme replaces and cancels Scheme R.101 made in 1946).	8,500
178C	do.	Research by Dr. G. A. Walton into the bionomics and distribution of ornithodorus ticks in relation to relapsing fever (supplementary provision).	1,400
198A	do.	Social Science Research Studentships (supplementary provision).	2,040
317	do.	Attendance of Dr. B. A. Keen, Director of East Africa Agriculture and Forestry Research Organisation, as representative of the Colonial Empire at the Australian Conference on Plant and Animal Nutrition in relation to soil and climatic factors.	695
298	do.	Colonial Research Fellowships ... Provision for further fellowships over a period of five years under a revised scheme.	37,500
310	do.	Malaria Research by Dr. R. C. Muirhead-Thomson at the London School of Hygiene and Tropical Medicine.	1,200
131A	do.	Appointment of joint secretary of the Colonial Medical Research Council for three years; extension of scheme.	4,000
	Africa:—		
237	General	Linguistic Research in West Africa, Equatorial Africa and the Belgian Congo. Survey of the Northern Bantu borderland.	3,360
41A	do.	Ethnographic survey of Africa (supplementary provision).	950
148B	do.	Enquiry by Dr. Northcott and others into the efficiency of African labour (supplementary provision).	25

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	Africa—*contd.*		£
253	General	Study of African Marriage Customs sponsored by the International African Institute and the International Missionary Council. (The total cost of the investigation is estimated at approximately £4,700 towards which the Carnegie Corporation of New York are contributing $12,000).	1,785
259	do.	Enquiry into shifting cultivation in the African Colonial territories.	1,240
28D	do.	Preparation of the Handbook of African Languages (supplementary provision).	2,290
104(*a*)B	do.	Study of French administration in North Africa by Miss E. Crowe (supplementary provision).	260
309	do.	Research by Mr. J. S. Perry into the reproduction and embryology of the African elephant.	1,100
	East Africa:—		
244	General	Establishment of an East African Bureau of Research in Medicine and Hygiene. The grant covers capital expenditure of £4,000 and one half of the estimated recurrent expenditure, spread over a period of 4 years, the other moiety being defrayed by the East African Governments).	14,600
173C 173D 173E	do.	Establishment of an East African Medical Survey, Provision for the appointment of a Director and subordinate staff for three years equipment, passages, etc.	46,680
262	do.	Preparation of a Flora of East Africa by the Royal Botanic Gardens, Kew, over a period of 5 years.	16,000
276 276A	do.	Research into Meteorological data and systems of permanent husbandry.	1,830
280	do.	Survey of problems of food storage in the East and Central African territories.	985
126B	do.	Tsetse and trypanosomiasis research (supplementary provision).	4,000
290	do.	Malaria research to be undertaken by a medical specialist in collaboration with the East African Insecticides Research Unit for 2 years.	3,270

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	East Africa—*contd.*		£
125(*a*)C 125(*a*)D 125(*a*)E 151B 293 316	General	Virus research Institute, Entebbe ... Maintenance for 1947 (supplementary provision), for 1948 (supmentary provision) and 1949; also provision for further laboratory staff. (Scheme R.293 replaces scheme R.142).	31,874
147D 147E I	do.	Investigation by Dr. W. H. R. Lumsden at the Virus Research Institute, Entebbe (supplementary provision).	550
232A	do.	Researches by Dr. R. W. Ross at the Virus Research Institute, Entebbe (supplementary provision).	212
302 302A	do.	Research by Mr. B. Weitz on the preparation of antisera for the identification of blood found in mosquitoes and other insects.	1,200
318	do.	Research for three years into the effects of Antrycide injections on cattle.	15,800
301	do.	Establishment of an East African Agriculture and Forestry Research Organisation and an East African Veterinary Research Organisation. Capital expenditure. (The grant covers the cost of road laying, the provision of power, light, telephones and water, the erection of offices, library and laboratories, the provision of equipment and the building of accommodation for European, Asian and African staff at the joint headquarters of the two Organisations at Muguga, Kenya; and also the cost of buildings and the provision of equipment for the Veterinary Research Organisation's laboratories at Kabete. The scheme replaces and cancels schemes R.92, R.153, R.153B, R.192 and R192A in so far as they refer to capital expenditure).	325,000
41B	do.	Ethnographic survey... ... ... Visit by Dr. Muirhead (supplementary provision).	550
248	Kenya	Establishment of a Coffee Research Station. (The total cost of the scheme is estimated at £34,374, towards which £5,000 is being contributed by the Kenya Coffee Board and £11,650 by the Government of Kenya).	17,724

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	East Africa—*contd.*		£
252 252A	Kenya	Anthropological study of the peoples of the Turkana district by Mr. P. H. Gulliver.	3,740
234A	do.	Anthropological research among the Teita people by Mr. H. Prins (supplementary provision).	321
254	do.	Sociological Research ... ... Publication of report by Professor Schapera, Cape Town University, on the sociological research needs of Kenya.	100
255	do.	Botanical Research at the Corydon Museum, Nairobi (two years).	1,130
257	do.	Study of Simulium control in Kenya and Uganda by Dr. B. de Meillon, South African Institute for Medical Research.	700
260	do.	Sociological Research ... ... Appointment of four sociologists (supplementary to Schemes R.83 and R.116).	5,000
200B	do.	Sociological Research ... ... Study of urban life and development in Kenya by Miss M. Parker (supplementary provision).	95
313	Uganda	Research into malnutrition diseases by Dr. J. N. P. Davies, Pathologist, Uganda Medical Department. Purchase of apparatus and materials.	1,140
267	Tanganyika	Vegetation of Tanganyika ... ... Photographing of a comprehensive map showing vegetation of the Territory.	100
308 308A	Zanzibar	Visit of a scientific mission to advise on the control of " Sudden Death " disease in cloves.	1,446
	Central Africa:—		
271	General	Psychological research in Northern Rhodesia and Nyasaland by Mr. M. G. Marwick.	300
307	Nyasaland	Tsetse fly survey over a period of three years.	26,830
314	do.	Study of Native Authority administration by Dr. Lucy Mair.	740
235A	Northern Rhodesia...	Agricultural Research (supplementary to Scheme R.235).	4,100

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	Central Africa—*contd.*		£
187A 187B 187C	Northern Rhodesia	Assistance towards the maintenance of Rhodes-Livingstone Institute.	3,825
223A	do.	Ecological Survey under the supervision of Mr. C. G. T. Morison (supplementary provision).	250
	West Africa:—		
90D	General	Pest Infestation Survey (supplementary provision).	200
242	do.	Helminthiasis Research ... ... Preliminary investigation into the incidence of loiasis by Professor R. M. Gordon.	400
273	do.	Fisheries Research ... ... Establishment of a West African Fisheries Research Institute—preliminary scheme. The grant, spread over a period of 2 years, covers capital expenditure (£135,400) to defray the cost of a research vessel, two seine boats, the provision of housing, laboratories and equipment, and one half of the recurrent expenditure on salaries, etc., the other moiety being met by contribution from the West African Governments. A further scheme to cover 5 full working years (1950–54) with a complement of scientific officers will be prepared later.	148,000
277	do.	Forestry Research ... ... Visit of Professor H. G. Champion, Department of Forestry, Oxford University, to West Africa to obtain first hand information on local forestry conditions.	435
125(*b*)B 125(*b*)C	do.	Medical Research ... ... Virus Research Institute, Lagos. Maintenance for 1948 (supplementary provision) and 1949.	15,055
283	do.	Nutrition Research ... ... Investigation into the suitability of the roller mill for milling millets and sorghum.	1,930
106A 106E	do.	Psychological Research by Dr. Geoffrey Tooth (supplementary provision).	890
199B	do.	Medical Research—Nutrition ... Research on the Gambia by Dr. R. H. Fox (supplementary provision).	2,000

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	West Africa—*contd.*		£
291	General	Medical Research ... ... Acquisition and equipping of the Sir Alfred Jones Laboratory at Freetown.	11,000
40B	do.	Medical Research by Dr. Muirhead Thomson (supplementary provision).	77
304	do.	Establishment of a West African Veterinary Research Organisation. The grant, spread over 3 years, provides for the appointment of a Director and an assistant and also for travelling and housing.	20,000
305	do.	Establishment of a West African Agricultural and Forestry Research Organisation. The grant, spread over three years, provides for the appointment of a Director and an assistant, and also for travelling and housing.	20,000
311	do.	Establishment of a West African Building Research Organisation. Appointment of a Director for three years.	7,035
272	Gambia	Nutrition Research ... ... Visit to Gambia Field Nutrition Unit by Dr. Burgess, Malayan Government Research Institute.	220
284	do.	Nutrition Research ... ... Reconditioning of buildings at the Nutrition Field Research Station.	5,000
213A	Gold Coast	Linguistic Research by Mr. J. Berry	210
263	do.	Economic and Social Research in the Manya-Krobo State by Mr. K. D. S. Baldwin.	325
268	do.	Research into the history of British relations with the Gold Coast by Miss F. Wolfson.	1,150
285	do.	Swollen Shoot disease of cocoa trees. Visit of a scientific mission to report on means of controlling the disease.	4,700
306	do.	Cocoa Research ... ... Visit of a Mission to explore the possibilities of the use of arboricides in connection with "Swollen Shoot" disease.	2,200
286	Nigeria	Establishment of a Malaria Service... The grant represents 70 per cent.	31,850

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	West Africa—*contd.*		£
	Nigeria	of the total assistance required for two years, the remaining 30 per cent. being defrayed from the Nigerian Development and Welfare allocation.	
315	do.	Psychological Research for two years by Dr. G. Tooth.	4,500
297	Sierra Leone ...	Sociological Research ... ... Preparation of material relating to the Mendi people collected by Dr. Hofstra.	100
299	do.	Employment of a systematic botanist to undertake a five years' study of the botany of forest and other vegetation.	5,150
300	do.	Establishment of a Rice Research Station at Rokupr (capital expenditure).	43,400
	South Africa High Commission Territories:—		
195A	Basutoland	Land Tenure Survey by Mr. V. Sheddick (supplementary provision).	300
	Middle East:—		
67A	Aden	Publication of a Report by Mrs. W. H. Ingrams on social and economic conditions in Aden Protectorate (supplementary provision).	450
214A 214B	do.	Fishery Survey of the Gulf of Aden (supplementary provision).	7,512
	Indian Ocean:—		
88I	Mauritius	Fisheries Research ... ... Supplementary provision for scientific equipment for the survey of fisheries in the Mauritius–Seychelles area.	1,000
38A	do.	Biological control of the weed cordia macrostachya. Extension of duration of investigation to four years. (The grant represents one-half of the estimated total cost; the other moiety is being defrayed by the Government of Mauritius.)	3,230
	South East Asia:—		
161A	General	Preparation of an annotated bibliography of land tenure (supplementary provision).	300
256	do.	Preliminary study in the United Kingdom by seven sociological research workers selected to carry out sociological research in Malaya and Sarawak.	800

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	South East Asia—*contd.*		£
281 281A	Singapore	Sociological Research ... ... Investigation over a period of two years by Mr. and Mrs. Freedman.	7,021
278	Federation of Malaya	Timber Research ... ... Visit of a Timber Research Officer to attend conference in Canada on timber mechanics and allied subjects.	585
288	do.	Establishment of an Institute for Research and Training in Fish Farming on Penang Island. (Grant is for capital expenditure, including acquisition and layout of site, building of laboratories and living quarters, furniture, plant and equipment and construction of fish ponds.)	252,000
303	Federation of Malaya	Malaria control ... ... Experiments in the use of D.D.T. against *anopheles maculatus.*	350
270 270A 270B	Sarawak	Sociological Research ... ... Investigations by four research workers over a period of two years.	8,364
246	North Borneo ...	Medical Research ... ... Publication of report by Dr. J. MacArthur on malarial investigations in North Borneo.	120
282	Hong Kong	Construction of a Fisheries Research Station. The grant is for capital expenditure only; the recurrent expenditure will be defrayed by the Government of Hong Kong.	135,000
	Pacific		
206A 206B 206C	Fiji	Linguistic research in Fiji by Mr. G. B. Milner. (Supplementary provision).	1,765
287	do.	Establishment of a medical research library.	3,650
	West Indies		
93D(C)	General	Psychological research by Mr. B. J. Bedell (supplementary provision).	327
236 236A 236B	do.	Establishment of the Colonial Microbiological Research Institute in Trinidad (capital and recurrent expenditure for five years).	116,900
251	do.	Provision of a house for the Director of the projected Department of Social and Economic Research, West Indies University College, and for the salary etc., of the Director for five years.	15,000

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	West Indies—*contd.*		£
275	General	Cyto-genetical Research on Sugar Cane in the West Indies. The research will be carried out at the British West Indies Sugar Cane Breeding Station in Barbados. Grant spread over five years, for the building and equipment of a Laboratory (£5,000) and for the salary and travelling expenses of a cyto-geneticist of Principal Scientific Officer status. Also for the cost of assistants, labour, field equipment and books.	18,000
72A	Barbados	Appointment of a ceramist to investigate the possibilities of the development of the pottery, brick and tile making industry. (Supplementary grant spread over two years).	2,750
145D	Jamaica	Sociological Research by a team working under the direction of Miss Edith Clarke (supplementary provision).	3,750
54B	Leeward and Windward Islands.	Control of food crop pests ... ... (Supplementary to Scheme R.54)	900
218A	do.	Study of Natural Vegetation (publication of a report by Dr. J. Beard (supplementary provision).	65
171B	Trinidad	Research into vacuum-oil food drying processes (supplementary provision).	178
228A	do.	Ecological survey of secondary forest growth by Mr. Grieg-Smith (supplementary provision).	65
46A	British Guiana ...	Trials with D.D.T. (supplementary provision).	38
201A	British Honduras ...	Enquiry into the possibilities of developing cassava starch production (supplementary provision).	50
	Mediterranean:—		
265 265A	Malta	Research into *Brucella melitensis* over a period of four years in the United Kingdom. (This scheme replaces Scheme R.112 made in 1946).	55,255
249	Cyprus	Mosquito eradication campaign ... Visit by Dr. J. R. Busvine, London School of Hygiene and Tropical Medicine.	200

Scheme No. (Prefix R)	Benefiting Territory	Description of Scheme	Amount
	Atlantic :—		£
312	Falkland Islands ...	Establishment of a bureau to deal with the Falkland Islands Dependencies Survey data and specimens. (Grant provides for expenditure over three years).	10,200
		TOTAL	£1,652,169

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	1,666,169*	5,913,795*

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, 1949, and totalling £80,495 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, 1940–49

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	741,702
Total	£1,539,416

APPENDIX II

COLONIAL RESEARCH FELLOWSHIPS

Grant of Fellowships during the years 1949-1953

In 1944 the Secretary of State for the Colonies instituted a number of Colonial Research Fellowships to encourage qualified scientists to give special attention to Colonial problems and to enable them to pursue research work in the British Colonial Empire.

2. The Secretary of State has decided to continue to grant Fellowships during the next five years, the cost of which will be defrayed from funds provided under the Colonial Development and Welfare Acts. No limitation is placed on the type of research for which Fellowships may be granted, provided that it is likely to be of definite value to the Governments of the territory or territories in which it is to be undertaken.

Qualifications of Applicants

3. The Fellowships will normally be reserved for University graduates in the natural or social sciences under 35 years of age from any part of the British Commonwealth and Empire. Candidates must already have had experience of research and must give evidence that they have the ability to plan and prosecute investigations of a high quality without close and constant supervision. The plan of research submitted should be reasonable and concise and should indicate clearly the nature of the problem which the candidate wishes to investigate. In choosing the subject the candidate should bear in mind its relevance to Colonial Development and Welfare, and whether or not the facilities required do, in fact, exist in the region chosen, and the undesirability of suggesting a piece of research which has already been made the subject of extensive investigations.

Terms of Award

4. Fellowships which will be tenable only in the non-self-governing British Colonial territories and not in the United Kingdom, or other Commonwealth countries including Southern Rhodesia, will be granted for a period of not more than three years. Under exceptional circumstances arrangements may be made for the Fellowship to include a brief period of work in the United Kingdom, but it should be noted that the Fellowships are intended primarily for original field work and not for advanced study. Where practicable, Fellows will be attached to appropriate centres of learning in the Colonies and may be required to give occasional lectures of general interest on their subject for the benefit of students attending at the centres.

5. During his tenure a Fellow will be responsible to a supervisor or supervisory committee selected by the Secretary of State. If the supervisor is not resident in the territory visited, the Secretary of State may appoint, in consultation with him, a deputy supervisor in that territory or in a neighbouring territory.

6. The Fellow will be required to submit to the Secretary of State through his supervisor a concise report at the end of each year of his tenure of the Fellowship and a final report of his researches within a specified time on the completion of his tenure. The results of such researches may be published by the Fellow from time to time as may be thought best, and a copy of the publication shall be sent to the Colonial Office; but the Secretary of State reserves the right to require that publication should be undertaken by H.M. Stationery Office. Copyright in these reports will become the property of the Crown and reproduction of this material would require the prior permission of the Secretary of State. No commercial use shall be made of the results of the researches except on such conditions as the Secretary of State may approve.

7. Fellowships will normally carry salary varying up to a maximum of £575 per annum. In addition, for periods of the Fellowship necessarily spent abroad a Foreign Service Allowance would be payable at rates and subject to the conditions laid down from time to time by the Treasury for members of the Home Civil Service. Travelling expenses and the cost of any essential apparatus or material required for the Fellow's research will also be provided. Where a Fellow is a member of a superannuation scheme in which his employer pays part of the contributions, the Secretary of State will, if necessary, also accept responsibility for the payment of the employer's contributions for the duration of the Fellowship. The salary is liable to assessment to United Kingdom Income Tax, but generally, provided that the absence abroad includes a full financial year and that the salary carried by the Fellowship is not over £600 per annum, it is not anticipated that such liability would be enforced for periods spent overseas. In other circumstances, the Fellow may incur a liability to assessment in the normal way under Schedule D of the Income Tax Acts. Any Fellow in doubt

on this point should consult the Chief Accountant at the Colonial Office, or the Inspector of Taxes of the area in which he resides. The Foreign Service Allowance is not subject to United Kingdom Income Tax.

8. The award of a Fellowship carries no guarantee of future employment, but satisfactory performance by a Fellow will be given due weight as a recommendation if application is later made for official appointment in the Colonies.

9. The award will be conditional on the candidate being certified medically fit for the type of work to be undertaken. Application forms can be obtained from and should be addressed in the first instance to the Under Secretary of State (Research Department), Colonial Office, London, S.W.1.

Colonial Office,
Sanctuary Buildings,
Great Smith Street,
S.W.1.

June, 1949.

Colonial Products Research Council Sixth Annual Report (1948-1949)

Ministry of Labour,
80–82 Pall Mall,
London, S.W.1.
18th May, 1949.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Products Research Council for the year 1948–1949.

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

The Right Honourable A. Creech Jones, 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.

SIR JOHN FRYER, K.B.E., M.A., F.R.S., Secretary, Agricultural Research Council.

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

PROFESSOR SIR IAN HEILBRON, D.S.O., D.Sc., LL.D., F.R.S., Professor of Organic Chemistry, Imperial College of Science and Technology, London.

SIR HARRY LINDSAY, K.C.I.E., C.B.E., Director of the Imperial Institute.

SIR EDWARD MELLANBY, G.B.E., K.C.B., M.D., D.Sc., F.R.C.P., F.R.S., K.H.P., Secretary, Medical Research Council.

PROFESSOR SIR JOHN L. SIMONSEN, D.Sc., F.R.I.C., F.R.S., Director of Research.

MR. G. THOMSON, General Council, Trades Union Congress.

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.,
MR. J. G. HIBBERT, C.M.G., M.C. } Joint Secretaries.

The terms of reference of the Council are:—

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

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

COLONIAL PRODUCTS RESEARCH COUNCIL

SIXTH ANNUAL REPORT

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COLONIAL PRODUCTS RESEARCH COUNCIL

SIXTH ANNUAL REPORT

PART I. GENERAL

The Council suffered a very great loss in the death of Sir John Fryer, K.B.E., M.A., F.R.S., Secretary of the Agricultural Research Council, in November, 1948. He had been a member since 1944 and took a very keen interest in the Council's activities.

2. Sir Ian Heilbron, D.S.O., D.Sc., LL.D., F.R.S., and Sir Harry Lindsay, K.C.I.E., C.B.E., both members of the Council since its inception in 1943, retired during the year under review. Sir Ian Heilbron was also a member of the Technical Sub-Committee of the Council. The Council wishes to record its thanks to these two members for their services.

3. The Council learns with great pleasure of the selection by the American Chemical Society of Sir John Simonsen, F.R.S., as the first recipient of the Fritzsche Award. This award, which consists of a gold medal and $1,000 was established to "recognise and encourage outstanding achievement in analysis, research and new applications of essential oils, essential oil isolates, and related chemicals." The presentation of the award is to take place at the autumn meeting of the American Chemical Society to be held at Atlantic City, New Jersey.

4. The most important event in the Council's activities during the year was the official opening of the Colonial Microbiological Research Institute in Trinidad. The ceremony of the opening was performed on 5th July by Lord Hankey in the presence of a distinguished gathering including the Governor of Trinidad and Tobago, Sir John Shaw; the Chairman of the Standing Closer Relations Committee, Sir Hubert Rance; Sir John Simonsen, Director of Research of the Council; the Principal of the University College, Jamaica, Dr. T. W. J. Taylor; the acting Principal of the Imperial College of Tropical Agriculture, Trinidad, Dr. Shepherd; delegates from the British Caribbean countries, from other countries of the Caribbean Council, from the United States, and from a number of the South American republics.

5. Following the official opening two morning sessions of discussions were held on 6th and 7th July in the library of the Institute. At the first of these Lord Hankey took the chair, and at the second Sir John Simonsen presided. Many delegates and others read papers at these meetings, which were well attended. A brochure has now been published including the papers read and giving a description and sketch of the Institute. Copies are obtainable from the Director of the Colonial Microbiological Research Institute.

6. The Institute forms a centre for Colonial microbiological research situated within the tropics and is the only one of its kind in the Colonial Empire. It will devote its energies to fundamental research in microbiology; to the application of the results of its investigations and to assisting agricultural and other industries in improving their products. Further it is hoped that the Institute will become a centre for post-graduate training in microbiology. The Institute will also form part of a Commonwealth scheme for the establishment of a number of culture collections of micro-organisms which will be made freely available to other microbiologists.

7. The laboratory building is air conditioned throughout and includes in addition to offices and staff rooms, a library and six laboratories. Three of these laboratories are for microbiology, and one for bio-chemical research; another laboratory is reserved for the type culture collection and one for the preparation of culture media.

8. As some of the investigations which the Institute expect to undertake will have industrial application, it was decided to incorporate a pilot plant in the design of the Institute. Tenders for the construction of the pilot plant building have been called for and it is hoped that its erection will not be long delayed. The building will house a complete fermentation plant of 400-gallon capacity and a distillation unit, in addition to a boiler house, gas plant, air compressor unit and machine shop. The staff of the Microbiological Research Institute are housed in a block of four flats, erected within the grounds of the Institute ; a bungalow has also been erected for the engineer.

9. A detailed account of the opening of the Colonial Microbiological Research Institute appeared in "Nature," September 25th, and a fuller description of the Institute in "Nature," July 3rd.

10. Although the laboratory was officially opened in July naturally much had to be done before it was possible to commence work. Dr. W. G. C. Forsyth, the Biochemist, arrived in Trinidad in September, and Mr. G. E. Rombouts, the Chief Microbiologist, in November. After their arrival a research programme was prepared and this was approved by the Council at its meeting on 18th November, 1948.

11. In the West Indian islands great difficulty is encountered in the disposal of rum distillery wastes. Results have now been obtained which suggest a partial solution of this problem (see paragraph 48). The possibility of using pure cultures in fermentations is being studied.

12. Another problem of great interest, not only to the West Indies, but also the Gold Coast and Nigeria, is that of the cocoa bean fermentation. There is little doubt that the flavour of the bean is largely dependent on the conditions under which it is fermented and whilst Mr. G. E. Rombouts is studying the micro-flora involved, Dr. Forsyth is examining the chemical constituents of the bean. In connection with this research samples of cacao beans have already been sent by the Director to Dr. L. E. Campbell, British Food Manufacturing Industries Research Association.

13. A commencement has also been made on the possibility of the isolation of antibiotics from tropical soil organisms. Work in this field, which affords very great experimental difficulties is generally regarded as being one of fundamental importance and if successful might provide valuable compounds to combat plant diseases arising from organisms in the soil.

14. It has been the intention of the Council that, although the Microbiological Research Institute is situated in Trinidad, it should be regarded as a research centre for all the Colonies. Not only will the Institute work in close co-operation with other research organisations in the West Indies, but its resources are available to those working on related problems in other branches of Colonial research throughout the Commonwealth. It is therefore gratifying to record that the Director has been consulted by Mauritius and by the Seychelles and has been able to render assistance to these widely separated territories.

15. The Hankey Culture Collection now comprises 153 cultures and these have been detailed in a catalogue forwarded to the British Commonwealth Type Culture Collection. Pure cultures have already been sent not only to the Colonies but also to Commonwealth and foreign countries.

16. The building to accommodate the Institute's pilot plant has still to be erected and until this has been done it will not be possible to take full advantage of the researches which are being carried out in the laboratory.

17. Close contact has been maintained by the Director of Research with industrial organisations, who have been encouraged in their efforts to develop industries based on Colonial products. A particularly interesting example of this relates to the steps taken by one firm to develop a method of manufacture of dextran from sugar to be used as a substitute for blood plasma. Clinical trials have shown that dextran can replace blood plasma to approximately 50 per cent., and the firm were prepared to proceed with production on a semi-commercial scale provided an adequate allocation of sugar could be obtained. Through the representations of the Director of Research, the Ministry of Food has agreed to make available sufficient sugar to meet the firm's immediate requirements.

18. Reference was made in the last Annual Report to an industrial research organisation which, working in conjunction with the sisal industry in East Africa, has been carrying out important research on by-products from the sisal plant. The Director of Research of the Council continues to keep in very close touch with this organisation's research activities and has visited its laboratories on a number of occasions.

19. One of the main items of the Council's research programme has been the study of the chemistry of sugar and starch, which has had as its objective the increase in their industrial uses. The success so far achieved has been due in a large measure to the originality and enthusiasm of Professor Sir Norman Haworth. It is therefore with much regret that the Council has learned of his retirement from the chair of chemistry at the University of Birmingham. This has necessitated some changes in the continuance of this research.

20. Work on the chemistry of sucrose will continue in Birmingham under the general supervision of Professor M. Stacey, in whose laboratory Dr. L. F. Wiggins will work until his new Sugar Research Laboratory at the Imperial College of Tropical Agriculture is available. The investigation of starch will, in future, be carried out by Professor S. Peat, who has left Birmingham on his appointment to the chair of chemistry at the University College of North Wales, Bangor.

21. The shortage of research assistants has limited progress in the study of sucrose derivatives and the Council regrets to have to report that Mrs. Gregory, who has assisted in the supervision of this research at Birmingham, resigned her appointment at the end of December. It desires to place on record its appreciation of her valuable work. In spite of these difficulties, results of considerable importance have been obtained. Perhaps the most important advance to be recorded has been the opening up of a new field of carbohydrate chemistry by the preparation of fluorine derivatives. The development of this work, which is still in its preliminary stages, will be followed with great interest.

22. It may be that the increase in sugar production which is now taking place, will make possible the commercial utilisation of some of the results of the work carried out on behalf of the Council. Many of these developments could best be carried out in the Colonies and it will be one of the main functions of the Sugar Research Laboratory at the Imperial College of Tropical Agriculture to further this aim. In this connection attention is drawn to the list of patents in Appendix II, which have already been granted.

23. Professor Sir Norman Haworth, Dr. S. Peat and their collaborators have, for a number of years, been engaged in the study of the action of enzymes on the two starch constituents amylose and amylopectin, for the separation of which convenient methods are now available. Possible technical application of this fundamental work has emerged from the observation that

the so-called "Q" enzyme converts amylose into amylopectin. Since the latter, a non-retrograding starch, is used in the textile, paper and other industries this discovery may prove to be of industrial value.

24. The interesting pharmacological properties shown by many of the pyridazine derivatives prepared by Dr. Wiggins and his collaborators has necessitated an increase in the staff working under Professor A. C. Frazer's direction. His chief assistant, Mrs. Wadja, resigned her appointment during the year and she has been replaced by Miss Weston. Mrs. Wadja has drafted a report on her work for publication and the Council is much indebted to her for the invaluable assistance she has given. Arrangements are being made to submit a number of compounds for clinical trials.

25. Professor T. P. Hilditch and his collaborators have continued to make most valuable contributions to our knowledge of vegetable oils which are available from Colonial sources. Further quantities of heat treated "conophor" seeds, from *Tetracarpidium conophorum*, have been received from Nigeria and the oil was expressed by the British Oil & Cake Mills of Hull. These seeds were obtained in part by the Board of Trade and the Ministry of Food and their extraction at Hull has enabled problems relating to its commercial processing to be examined. The oil was of excellent quality and it is clear that there is no technical difficulty in the heat treatment of the seeds. The Department of Agriculture, Nigeria, have continued on a large scale their experiments on the cultivation of the vine but it will naturally be a considerable time before it can be determined if this will be successful.

26. Unfortunately the present disturbed conditions in Malaya have prevented the large scale experiments which it was hoped would be undertaken with the collection of rubber seed, to which reference was made in last year's report (para. 7). A quantity of rubber seeds was, however, obtained by the Ministry of Food from Nigeria and the oil from these seeds was extracted by Messrs. Bibby & Co. Experiments carried out by Messrs. Bibby & Co. and also in Professor Hilditch's laboratory have shown that if rubber seed oil is to be obtained free from dispersed rubber it will have to be solvent extracted with acetone.

27. The oils obtained from niger seeds, safflower seed and sunflower seeds of suitable varieties from East Africa and Rhodesia are of a high linoleic acid content and it is clear from Professor Hilditch's work (see para. 43), that they should be of equal if not superior value in the paint industry to soya bean oil.

28. One point, which may prove to be of great importance, has emerged from this work. Whilst there is no doubt that the botanical variety of the plant from which the seed is obtained influences its composition, this is also very greatly influenced by the environmental conditions, temperature and soil, under which the plant is grown. Too little attention would appear to have been paid in the past to this aspect of the cultivation of oil seeds. It should be further pointed out that whilst an oil with a high linoleic acid content is required by the paint industry an oil with a lower unsaturated acid content, will be of greater value for conversion into edible oils. Professor Hilditch gave an account of his work on the occasion of the annual meeting of the Oil and Colour Chemists Association, Liverpool, last September. The Council has noted with pleasure that the Association recognised the outstanding importance of Professor Hilditch's work by electing him to an Honorary Membership.

29. It has been found in Australia that candlenut (lumbang) oil from the nuts of *Aleurites tribola* grown in Fiji can, to a large extent, replace linseed oil as a general purposes oil in the paint industry.

Since the tree, from which these nuts are obtained in excellent yield, will grow readily in many Colonies, the Council, at the request of the Colonial Primary Products Committee, has arranged for experiments to be carried out to find a satisfactory method for the decortication of the nuts. Until this information is available it will not be possible to recommend any large scale extension of the planting of this tree.

30. The present chemical methods for the estimation of the pyrethrin content of pyrethrum flowers have caused much difficulty to the Kenya Pyrethrum Board.

During a visit to East Africa in 1946 Sir Ian Heilbron and the Director suggested that it might prove possible to overcome this difficulty by spectroscopic methods of assay. Utilising ultra-violet absorption, Mr. Beckley, Kenya, has obtained interesting results and the Council has now arranged for a detailed study of the subject to be made under the direction of Dr. S. H. Harper in King's College. It is proposed to try both ultra-violet absorption and infra-red spectroscopic methods of assay.

31. Work on the germination factor of *Striga hermonthica* has advanced sufficiently for a paper on this subject to be communicated by Professor A. R. Todd and his collaborators to the Royal Society. It would appear to have been established that the factor is a carbohydrate, but much work will obviously be required, particularly in the agricultural field, before it can be determined whether it will be possible to develop a biological method of control for this parasite.

32. In 1945 it was reported in France that the plant *Hydrocotyle asiatica* had proved of value in the clinical treatment of leprosy. It was therefore of interest to examine the extracts of the plant grown in Ceylon and this has now been extended to a study of the plant growing in Assam whilst arrangements have been made for the collection of material from Uganda. It has been found that the constituents present in Ceylon and Assam varieties are different and are different also from the constituents present in the Madagascar variety, which is being studied by Professor Lederer in Paris.

Dr. Lythgoe, who is directing the work on behalf of the Council, and Dr. Lederer have been able to make a direct comparison of their products and a note on their work has been published in " Nature."

33. The investigations being carried out by Dr. J. C. Smith and Mr. G. Pickering in collaboration with Trinidad Leaseholds Ltd. on the alkylnaphthalenes have been continued and they have resulted in the preparation of an alkylnaphthalene sulphonic acid of detergent and wetting properties comparable with those of the best commercial products.

34. Owing to the great delay in obtaining the necessary equipment for the projected work on the production of hardboards from secondary Colonial timbers, it has not been found possible to commence this work. Part of the plant has been received at Princes Risborough and it is hoped that the installation may be completed by the end of 1949. The delay has not been altogether unfortunate since Mr. Campbell of the Forest Products Research Laboratory, Princes Risborough, during a brief visit to the United States in the summer of 1948, was able to obtain much valuable information on this subject. Since his earlier visit in 1944 there have been considerable advances. In the meantime an analytical survey is being made of Colonial timbers and an investigation is being carried out on a saponin obtained from the wood of *Mora excelsa* and related timbers from British Guiana and Trinidad.

35. On his way back to the United Kingdom after the opening of the Colonial Microbiological Research Institute, the Director of Research broke his journey to visit Jamaica. He discussed with the Acting Governor, Mr. D. C. MacGillivray, the Director of Commerce and Industries and other officials problems relating to local industries, particularly the citrus industry, and ways in which the Council might be able to assist. He further had the opportunity of talks with the Principal of the new University College of the West Indies and a very close liaison has been established between the University and the Council, especially in regard to research work being conducted at the Colonial Microbiological Research Institute in Trinidad.

36. Colonial industries will naturally look to the newly established Colonial Universities to provide them with their scientific staff. It will be one of the functions of the Council to assist these Universities by the provision of maintenance grants for the training of research students as the Department of Scientific and Industrial Research does in Great Britain. It is therefore gratifying to record that a maintenance grant has been given during the year to a Jamaican student, Miss Leila Wong, who will work under the supervision of Professor Hassall in the Chemistry Department of the University College of the West Indies.

37. The Director of Research visited Sweden and Finland from the 9th to 17th April, 1948, at the invitation of the Swedish Chemical Society and the Association of Finnish Chemists. In each country he gave two lectures, one on terpene chemistry and the other on the work of the Colonial Products Research Council. During his visit he had numerous opportunities of making known the work of the Council.

PART II. REVIEW OF RESEARCH WORK IN PROGRESS

Clove Oil

38. (18)* Reference was made in last year's report to the preparation by Mr. W. A. Cummings, working in Professor Clemo's laboratory, of an optically active aldehydo-acid derived from vanillin. This work has now been successfully completed and a paper on the subject has been communicated to the Chemical Society.

An attempt has been made to apply the technically important "OXO" reaction to eugenol. This reaction results in the addition of the group -CHO and of hydrogen to ethylenic linkages yielding either an aldehyde or more generally an alcohol. Unfortunately neither of these derivatives were obtained from eugenol since complete reduction occurred with the formation of 3-methoxy-4-hydroxy*iso*butylbenzene.

In another series of experiments the reaction due to Karasch, which involves the addition of α-bromo esters to olefines, was investigated. It was found that eugenol and its methyl ether reacted quite readily with ethyl bromoacetate. From the methyl ether δ-3:4-dimethoxy-γ-valerolactone was obtained in good yield.

Mr. Cummings has also carried out a large number of experiments with dehydrodieugenol and 2-hydroxy-3-methoxy-5-allylbenzaldehyde, both of which can be obtained quite readily from eugenol. These experiments are still incomplete.

Petroleum

39. (19) The investigation of the isomeric alkylnaphthalenes which has now been completed by Dr. J. C. Smith and Mr. G. B. Pickering, has been

* Figures in parentheses refer to the corresponding paragraph in the 1947-1948 Report.

extended, in collaboration with Trinidad Leaseholds Ltd., to a study of the sodium salts of the sulphonic acids derived from them as wetting agents and detergents. As a preliminary to this work sulphonic acids prepared from diphenyl, diphenylmethane, *cyclo*hexylbenzene and *cyclo*hexylphenylmethane were examined. Only one of these was found to be of any value, namely, the sodium salt of hexadrobenzylphenyl-*p*-sulphonic acid. An examination of the sulphonic acids derived from various alkylnaphthalenes has resulted in the discovery of one which, as a wetting agent, is comparable with the best commercial products. It is obviously important that the position of the sulphonic acid group in this naphthalene derivative should be orientated and experiments in this direction are in progress.

Carbohydrates

40. (20) *Sugar.* The work carried out under the direction of Dr. L. F. Wiggins has been directed mainly (*a*) to a study of the chemistry of materials obtained from sucrose by chemical means, levulinic acid, mannitol and sorbitol, and (*b*) to the possible utilisation of three products derived from sucrose by the action of micro-organisms, kojic acid, itaconic acid and 5-ketogluconic acid which can all be prepared by known methods in fair yields.

In view of the promising results which have already been obtained a large number of pyridazine derivatives have been prepared from levulinic acid and these are now being examined by Professor A. C. Frazer to determine whether they are likely to be of any therapeutic value.

The preparation of many of the substances which are required for these investigations can be undertaken by a technical assistant, and it is hoped that it may, in the near future, be possible to obtain the services of one.

Since the anhydrides of mannitol and sorbitol appear likely to be of value for the preparation of substances suitable for use in the plastics industry, attention has been directed to a study of the structure of certain by-products which are formed in the dehydration of the two hexitols, while a commencement has been made in the examination of the pyrolysis of mannitol and sorbitol formates. One of the products of pyrolysis is 2-vinyldihydrofuran.

Although kojic acid has been known for a considerable time it has not so far been found possible to prepare from it any substance of technical value. Up to the present Dr. Wiggins' experiments have been equally unsuccessful, but in view of the ready accessibility of this acid it is desirable that work in this field should be continued.

The interesting observation has been made that diallyl itaconate in admixture with polymethylmethacrylate yields a plastic which is superior in abrasive properties to that made from polymethylmethacrylate alone when used in the manufacture of dentures. This investigation has been carried out in collaboration with Professor J. Osborn in the Department of Dental Prosthetics in the University of Birmingham.

Finally a commencement has been made of the study of various derivatives of 5-ketogluconic acid. This may open up an interesting and important field of research.

Professor M. Stacey and Mrs. Tatlow have commenced a study of the fluorine derivatives of the carbohydrates. By the action of trifluoroacetic anhydride on *D*-mannitol, *D*-mannitol hexatrifluoroacetate has been prepared, while from 4:6-benzylidene-α-methylglucoside a monotrifluoroacetate has been obtained.

New techniques are now being studied for the isolation of these very soluble products.

41. (41) *Starch.* Professor S. Peat and his collaborators have succeeded in devising new and rapid methods for the isolation of the two important P. and Q. enzymes. By the use of the purified Q. enzyme it has been found possible to convert amylose into amylopectin. These observations may prove to be of industrial value since it will provide a method for the conversion of industrial starches into the non-retrograding starches of the waxy-maize type. The advantage of this type of starch in the food, paper and other industries is well known.

Considerable attention has also been paid to the amylases which are responsible for the hydrolytic breakdown of starch. The soya bean amylase would appear to contain, in addition to the crystalline -amylase of Dr. K. Balls, an additional amylase.

In collaboration with Professor S. Peat, Miss M. G. Nicholls made a preliminary study of the East African starch, *Uwaga,* which was isolated by Mr. H. E. Watson. Whilst the starch resembles potato and cereal starches it gives on treatment with alkali, a gel which is of the amylopectin and not the amylose type. It is intended to study further this interesting starch.

Another important investigation is that concerned with the action of light on starch. It has been observed that a solution of starch exposed to ultra-violet light is completely decomposed to give carbon dioxide and the course of this photo-oxidation is being investigated. Other carbohydrates, such as cellulose, behave similarly and the reaction is obviously connected with the deterioration of carbohydrate material on exposure to sunlight. The subject is therefore one of considerable Colonial interest.

(a) *Pharmacological Investigations of Pyridazone and Related Compounds.* During the period January, 1947 to February, 1948, fifty-two compounds were tested in Professor Frazer's laboratory for their analgesic and local anaesthetic activity, while during this year a further twenty-eight compounds were received and similarly tested.

The analgesic potency of some of the more active were comparable to phenazone, whilst the local anaesthetic power was of the order of procaine. The investigations have revealed some other properties of the pyridazone molecule ; hypnosis, sedation and relaxation were noticed.

A test for anti-convulsant action was worked out using metrazol as the convulsant. A few substances were found to potentiate the metrazol convulsions and ten were found to prevent them.

In view of the predominant depressant and relaxing action of these compounds, it was considered advisable to test, for curare-like and antihistamine activity. The isolated rat diaphragm preparation, stimulated electrically, was used for the former ; none of the tested substances possessed any action on that preparation. Some of the substances were tested for anti-spasmodic action against histamine-induced contractions of the isolated rabbit intestine. All were without any activity, and they were also found to be inactive by themselves on rabbit and guinea-pig intestine.

The results indicate that there is no action on the neuromuscular function, nor directly on the muscle, and all the activity of these compounds, therefore, is due to the action on the central nervous system.

Timber Research

42. (22). *Mora excelsa.* By the extraction of the wood of *Mora excelsa* with alcohol, Mr. W. G. Campbell and Dr. R. H. Farmer have isolated an amorphous saponin. In most of the samples of wood which have been examined the saponin is present to the extent of 8-10 per cent., although

occasionally the content is only 3.5 per cent. The presence of saponins in wood has been observed previously, but the wood of *Mora excelsa* seems to be a relatively rich source. The wood of the related species, *M. gonggrijpii*, also contains a saponin. On hydrolysis the saponin yields the sugars glucose and xylose, together with a crystalline sapogenin. The latter may be of the steroid type having the formula $C_{23}H_{44}O_3$. This substance is being further studied since it may prove to be of therapeutic value.

Vegetable Oils

43. (24). Brief mention has been made in paragraph 25 of the importance and to the wide scope of the experiments on vegetable oils which are being carried out in Professor Hilditch's laboratory in the University of Liverpool. In this work, during the past year, he has been fortunate in having the skilled assistance of Dr. J. P. Riley, Assistant Lecturer in the Department of Inorganic and Physical Chemistry. He has not only personally carried out work on behalf of the Council, but he has also assisted younger workers in overcoming their difficulties. Unfortunately this arrangement will terminate at the end of the present session. Other assistants have been Dr. H. C. Dunn, who left in October to take up an industrial post, Mr. A. J. Seavell, Mr. C. Barker, Mr. A. Crossley and Mr. R. Crawford. Mr. Seavell will probably take up an industrial post at the end of this session and it is proposed, if possible, to obtain a further graduate assistant.

(a) *Conophor Oil* (Mr. A. J. Seavell). Although the experiments which had been recorded in previous reports have shown the potential value of this oil, much further work is naturally necessary before all the problems associated with its industrial development can be solved.

In September, 1948, 180 lbs. of heat treated nuts were received from Ibadan, Nigeria, through Messrs. Hartley and Irving of the Agricultural Department. These gave an excellent oil with an iodine value of 200-206 and a free fatty acid content of 0.3 to 0.4 per cent. Somewhat later in the year the Board of Trade obtained 750 lbs. of heat treated nuts from the same source. At the request of Mr. R. A. Jones, Board of Trade, and Mr. Harvey of the Ministry of Food small representative samples of these nuts were examined in Professor Hilditch's laboratory and the oil was expressed from the kernels at the British Oil and Cake Mills Limited, Hull. The extraction has not yet been completed but the oil appears to be of an excellent quality with an iodine value of 205-207 and free fatty acid content of 0.9 to 1.6 per cent. It is intended to have this oil sent to the Paint Research Station at Teddington for examination, while the cake will be distributed for animal feeding trials to the National Institute for Research in Dairying, Messrs. Bibby and Sons Limited, and the British Oil and Cake Mills Limited.

Heat treatment of conophor nuts would appear to be completely effective in preventing the development of free fatty acid since no increase in this has been observed in nuts kept for nine months to two years.

(b) *Rubber Seed* (Dr. H. C. Dunn, Mr. A. J. Seavell). Although as mentioned in paragraph 26 the disturbed conditions in Malaya have prevented the large scale collection of rubber seed which it had been hoped to arrange, two fairly large batches which were received from Malaya and Ceylon have been examined. Owing to the fact that the collection of the Malayan seeds (five tons) was undertaken somewhat late in the season the heat treated seeds had a fatty acid content of 7-10 per cent., which was higher than had been expected. The extraction of the oil was once more undertaken by Messrs. Bibby & Sons Ltd., for whose assistance the Council are most grateful. Rubber seed oil, when expressed in the usual manner, always

contains dispersed rubber (about 1 per cent.) and it has been found, as a result of the work in Professor Hilditch's laboratory and by Messrs. Bibby & Sons Ltd. that this can be removed by precipitation with acetone. It would appear certain, therefore, that if rubber seed oil should become available, as it is hoped, for industrial use the oil will have to be solvent extracted with acetone and not expressed. This is an observation of unusual importance since the number of plants available for such extraction is limited. It is hoped to arrange for Messrs. British Drug Houses to extract with acetone a quantity of rubber seed (four to five tons) received from Nigeria in July. Unfortunately the acid value of the oil from these seeds is high (10-28 per cent.) due to the fact that the seeds were damaged rather than to an ineffective heat treatment. This would appear to be confirmed by the fact that heat treated rubber seeds, which have been kept from nine months to two years in the laboratory, have shown no increase in free fatty acid content.

Rubber seeds from Ceylon have also been received. Two lots of these were obtained of which one had been heat treated without shelling and in the other the kernels were decorticated before heat treatment. The heat treatment was equally effective in both cases and it is probably better to heat treat the whole seeds as this facilitates decortication. The free fatty acid content of the Ceylon oil was 4 per cent.

(c) *Groundnut and Sunflower seeds* (Mr. A. Crossley). At the request of the Overseas Food Corporation the effect of heat treatment of groundnuts and sunflower seeds on the development of free fatty acid has been examined. It was found in all cases normal harvesting and sun curing was so efficient that the free fatty acid content was negligible. The oils were of excellent quality and there seems to be no need to resort to heat treatment in these cases. The component acids of the glycerides of the oil from these three varieties of groundnut selected for cultivation in Tanganyika are now being examined.

(d) *Component Acids of Niger seed, Safflower and Sunflower Seed Oils* (Messrs. H. C. Dunn, C. Barker and A. Crossley). An examination has been made of the component acids in Niger seed oil, safflower seed oil and a number of sunflower seed oils from East Africa and Southern Rhodesia. The chief points which have emerged from this study are:—

(i) The high quality of the seeds submitted and of the oils extracted from them.

(ii) The wide variation in linoleic and oleic acid content in the sunflower seeds.

(iii) Distinct evidence but not conclusive proof that the environment of the growing plant much more than the varietal difference, determined the proportion of linoleic and oleic acid in these Compositae oils. Reference has already been made in paragraph 27 to the importance of this work.

(e) *Component Acids of Tobacco Seed Oil* (Mr. R. Crawford). At the request of the Board of Trade the oil from Turkish tobacco seed was examined. The seed contains 35 per cent. of oil and a preliminary examination has shown it to resemble safflower seed oil in the high linoleic acid content (73 per cent.). According to a report by Messrs. Bibby & Sons Ltd., it should be possible to roll the seed and solvent extract the oil.

(f) *Component Acids of Parinarium laurinium Seed Fat* (Dr. Riley). The seed fat of fresh fruits received from Fiji has been further examined (Report 1947-1948, page 6). The component acids have been determined, the presence

of α -elaeostearic acids (30 per cent.) has been confirmed and parinaric acid (51 per cent.) has been shown to be octadeca -9, 11, 13, 15- tetraenoic acid.

(g) *The Component Acids of Castor Oils from different sources* (Dr. Riley and Mr. S. S. Gupta). The work started in 1943 on the ricinoleic acid content of castor oil from various Colonial sources had to be deferred until an accurate method for the estimation of this acid became available. Dr. Riley has devoted much time to this difficult problem and he has now been successful in greatly improving the method used.

The ricinoleic and component acids have now been determined in the 15 castor oils. The oils show remarkable consistency in composition, the ricinoleic acid varying from 91.2—94.9 per cent. with a mean value of 92.82 per cent. It is intended to examine the component glycerides in one or two of these oils.

(h) *Chemical Constitution of Drying Oils. Component Glycerides of Linolenic-rich Oils* (Conophor, Linseed, etc.) (Mr. A. J. Seavell). To be able to meet fully the requirements of the paint manufacturers, it is essential that a detailed knowledge should be available of the glyceride structure of the various drying oils. A commencement has now been made with

Table 1

COMPONENT GLYCERIDES OF CONOPHOR, ARGENTINE LINSEED, CANDLENUT AND RUBBERSEED OILS

	Conophor	Linseed Argentine	Candle Nut Australian	Candle Nut Hong Kong	Rubber-seed
IODINE VALUE	201·6	176·1	163·3	145·3	131·5
Component Acids:	Per cent. (wt.)	Per cent. (wt.)	Per cent. (wt.)	Per cent. (wt.)	Per cent. (wt.)
Saturated	12·0	17·2	13·5	13·8	23·5
Oleic	11·0	15·5	14·1	26·7	18·9
Linoleic	11·2	15·0	41·6	36·5	36·9
Linolenic	65·8	52·3	30·8	23·0	20·7
Component Glycerides:	Per cent. (mol.)	Per cent. (mol.)	Per cent. (mol.)	Per cent. (mol.)	Per cent. (mol.)
TRIPOLYETHENOID	36	25	27	—	4
Trilinolenin	10	Trace	—	—	—
Linoleodilinolenin ...	26	25	9	—	—
Dilinoleolinolenin ...	—	—	18	—	4
DIPOLYETHENOID	58	52	62	—	65
Dilinoleno-*	51	32	—	—	—
Linoleolinoleno* ...	7	20	54	—	54
Dilinoleo-*	—	—	8	—	11
MONOPOLYETHENOID ...	6	23	11	—	29
Linoleno-diolein ...	—	—	—	—	—
,, -oleo-std. ...	5	18	1	—	3
,, -disatd. ...	1	5	—	—	1
Linoleo-diolein ...	—	—	—	—	—
,, -oleo-satd. ...	—	—	8	—	21
,, -disatd. ...	—	—	2	—	4
NON-POLYETHENOID ...	0	0	0	—	2
Satd. dioleo	—	—	—	—	—
Disatd. mono-oleo ...	—	—	—	—	2
Trisaturated	—	—	—	—	—

* Oleo- or saturated

this very important work and the component glycerides of conophor, Argentine linseed, Australia and Hong-Kong candlenut and of rubber seed have now been determined. The results are given in Table 1. There is no doubt that with this knowledge and with that given in the next section it will be possible for paint manufacturers to obtain drying oils suitable to their requirements and to utilise them in a more economic manner than is the case at present.

The essential differences in the nature of the polyethenoid glycerides, dependent upon the varying proportions of the component acids in the whole oils, are already becoming apparent. When the series is completed it should be possible to correlate the glyceride structure and the requirements of the paint manufacturer (so far as he knows what he wants) with some approach to certainty.

(i) *Component Glycerides of Linoleic rich oils (Sunflower, etc.)* (Mr. C. Barker). The component glycerides of the oils from niger seed, safflower, sunflower are also under investigation.

This work is still in its early stages.

COMPONENT GLYCERIDES OF SUNFLOWER SEED AND SIMILAR OILS

	Niger Seed	Safflower Seed	Sunflower Seeds				
			S. Rhodesia	Kenya	Tangan-yika (S. Highlands)	Nigeria	Tangan-yika (Lake Prov.)
IODINE VALUE ...	134·9	142·5	136·9	132·3	129·8	126·7	113·7
Component Acids:	per cent. (wt.)	per cent. (wt.)	per cent. (wt.)	per cent. (wt.)	per cent. (wt.)	per cent. (wt.)	per cent. (wt.)
Saturated ...	20·7	9·6	13·5	14·7	14·2	12·0	12·7
Oleic	4·8	13·4	14·1	17·8	20·9	29·8	43·1
Linoleic ...	73·5	77·0	72·4	67·5	64·9	58·2	44·2
Linolenic ...	1·0	—	—	—	—	—	—
Component Glycerides:							
TRILINOLEIN ...		32	24	8			
DILINOLEO—		66	69	86			
Oleodilinolein		37	34	47			
Saturated dilinolein		29	35	39			
MONOLINOLEO—		2	7	6			
Saturated oleolinolein		1·5	6	6			
Disaturated linolein		0·5	1	0			
NON-LINOLEO—		0	0	0			

(j) *Stillingia Oil.* (Dr. H. C. Dunn, Mr. A. Crossley). Although stillingia oil is somewhat similar to rubber seed and candlenut oil it has been shown to contain an unsaturated acid of an unusual character. This acid has now been identified and it has been shown to be $CH_3.(CH_2)_4.CH:CH.CH:CH.CO_2H$.

The other acids present in the oil are now being investigated together with a study of its glyceride structure.

(k) *Component Acids and Glycerides of Stillingia Tallow.* (Dr. M. L. Meara and Mr. S. S. Gupta). Fruits from two species of Stillingia (*Sapium sebiferum*) and (*S. discolor*) have been received from Hong Kong. The fatty deposit, which occurs on the seed, technically known as Stillingia tallow or

Chinese vegetable tallow, has been examined by the usual methods used in the Liverpool laboratories. The results will be published in due course.

Plants of possible medicinal and insecticidal value

44. (25) (a) *Hydrocotyle asiatica.* Dr. Lythgoe and his collaborators, working in Professor A. R. Todd's laboratory in Cambridge, have separated from the Ceylon variety of the plant two triterpene acids, centoic and centillic acids. From the Assam variety two triterpene acids have also been separated. One of these is closely related to but differs from centoic and centellic acids; it gives a crystalline methyl ester and it contains an α-glycol system. The second acid present in the plant occurs in combination with a polysaccharide system, just as does centellic acid in the Ceylon plant, but the identity of the latter has not yet been established.

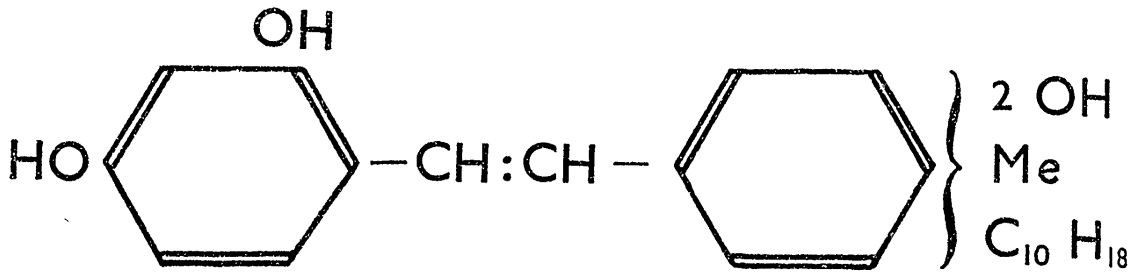
The Council is much indebted to Dr. Child for the valuable assistance which he has given in the collection of the Ceylon material.

(b) *Other Medicinal plants.* The investigation of a number of West African plant products has been very actively continued in Professor Cook's laboratory at the University of Glasgow. Dr. G. M. Badger and Mr. P. A. Ongley have shown that the bark of *Mitragyna inermis* contains the alkaloid rhynchophylline, but in a relatively small amount. A triterpene acid has also been isolated and identified as quinovic acid, the acid present in cinchona bark. This is of some interest as mitragyna and cinchona belong to the same natural order (*Rubiaceae*). In seeking better sources of mitragyna alkaloids, *Mitragyna rubrostipulacea* and *Mitragyna ciliata* have been examined. The former proved to be an excellent source of mitraphylline, which is apparently the simplest member of the series of mitragyna alkaloids; both bark and leaves were found to contain about 5g/kg. of alkaloid. *M.ciliata* has been found to contain rather less alkaloid. The leaves yielded 2g/kg. of rotundifoline, but the bark contained only traces of alkaloid. The isolation of rotundifoline from this source is noteworthy. The only other source of rotundifoline is *M.rotundifolia,* from which it was isolated, together with rhynchophylline, by Badger and co-workers (*J. Org. Chem.*, 1939, *4,* 418). Investigations into the inter-relationship of these alkaloids, and of their structures, are proceeding.

Dr. J. D. Loudon and Mr. P. McCloskey have begun an investigation of the alkaloids present in the seeds of *Picralima nitida* and are studying methods of separating the complex mixture of bases which these seeds contain.

(c) *Brachylaena hutchinsii.* Dr. J. C. Smith and Mr. G. Pickering have continued their study of the essential oil from this wood. They have found it to contain two dicyclic sesquiterpenes derived from cadalene, a sesquiterpene alcohol, and a sesquiterpene ketone. Experiments to identify these substances are in progress.

(d) *Chlorophora excelsa.* Professor F. E. King and Mr. M. H. Grundon, who are now working in the University of Nottingham, have continued their investigation of the phenol chlorophorin, to which reference was made in last year's report (page 45). It has been found that it has the formula $C_{25}H_{30}O_4$ and not $C_{18}H_{22}O_3$ as had been previously assumed. The determination of the structure of the phenol has given more difficulty than had been anticipated, but it now appears to be probable that it is a stilbene derivative derived from resorcinol. It is suggested that it can be represented by the partial structure (1), whilst the $C_{10}H_{18}$-side chain contains two ethylenic linkages being derived from $-CH_2.CH{:}C(Me_2)(CH_2)_3CHM_{e2}$.



(e) *Canarium schweinfurthii.* An investigation of the resin from *C. schweinfurthii* which is being carried out by Professor F. S. Spring, Mr. R. Bhuvanedrum and Mr. W. Manson in the Royal Technical College, Glasgow, has shown the resin to be a complex mixture from which the following substances have so far been isolated :—*d*-α-phellandrene, α-amyrin, β-amyrin, α-elemolic acid, β-elemolic acid and a diol $C_{30}H_{50}O_2$, which is related to α-elemioli caci d The investigation is being continued.

Striga hermonthica

45. (26). Professor A. R. Todd and Dr. A. W. Johnson at Cambridge and Dr. R. Brown and Mrs. C. N. Robinson at Leeds have continued their investigation of the germination factor of *Striga hermonthica.* It has been found that the keto-pentose, *D*-xyloketose, promotes germination at an even greater dilution than the natural factor, a significant germination having been observed at a concentration of $1/10^{10}$ in favourable cases. Like the natural factor, the activity of *D*-xyloketose deteriorates rapidly on keeping and it is normally inactive 4 to 5 days after its isolation. The causes of this inactivation are being studied at present.

Gums

46. (a) *Sterculia setigera.* The gum from *S.setigera* is being investigated by Professor E. L. Hirst, Dr. J. K. N. Jones and their collaborators. It has been found to resemble in its properties gum tragacanth and gum karaya. It is a partially acetylated polysaccharide and on hydrolysis it gives rise to the sugars *L*-rhamnose, *D*-galactose, *D*-galacturonic acid and *D*-tagatose. The presence of the last mentioned sugar is of peculiar interest since it is the first occasion on which its occurrence in nature has been reported.

(b) *Khaya senegalensis.* A preliminary examination by Professor E. L. Hirst of this gum has shown it to resemble very closely gum acacia. It is being studied in detail by Professor F. Smith.

Pyrethrum

47. For reasons given in paragraph 30, Miss M. W. Lowe working under the direction of Dr. S. H. Harper in the laboratory at King's College, has commenced an investigation having as its object the preparation of pure pyrethrins to serve as standards for the possible ultra-violet and infra-red spectroscopic assay of pyrethrum flowers. Utilising methods of purification which involve the use of Grignard reagent-T, Miss Lowe has prepared a sample of mixed pyrethrins assayed by the Wilcoxon-Holaday method as containing a very high percentage of pyrethrins. This sample is now being subjected to an infra-red spectroscopic examination in Dr. H. W. Thompson's laboratory at Oxford.

Colonial Microbiological Research Institute

48. (27) (a) *Rum Distillery Wastes.* Great difficulty is experienced in the disposal of rum distillery waste liquors. Results have now been obtained which suggest a partial solution of the problem. It has been found that it may prove possible to re-use such wastes in the preparation of fresh wort if the wash is treated with 1 per cent superphosphate and neutralized whilst it is still boiling. It appears that the spent liquor can effectively be used three times but it has still to be determined whether the distillate has the desired rum flavour. Work on this aspect of the problem cannot be carried out until the Institute's pilot plant is available. The final disposal of the waste liquors from the re-used fermentation has still to be investigated.

This work has led to the development of a method of pure culture fermentation of molasses worts. The method has been tried in Trinidad by one distillery with good results.

(b) *Cocoa fermentation.* Since the flavour of cocoa may be correlated with the type of organisms growing in the cocoa pulp during fermentation, Mr. Rombouts has commenced a study of this microflora. He has been able to examine beans not only in Trinidad but also in Grenada. These preliminary experiments indicate the production of toxic substances during fermentation which kill the young plant within the bean and that they may also be responsible for the decomposition of the pigments present in the bean which rapidly disappeared during fermentation. By the use of paper chromatography Dr. Forsyth has with considerable success been able to follow the chemical changes in the pigments. He has found that in the fresh Forestro bean there are present at least three anthocyanins, two leucoanthocyanins and one catechin. A further study of these pigments and of their destruction is now proceeding.

(c) *The Isolation of Antibiotics from Tropical Soil Organisms.* It was reported previously that an actinomycete was being investigated which produced an antibiotic attacking *Fusarium oxysporum cubense.* According to Meredith soils infested with this contain growth inhibiting substances, but it has not been found possible so far to confirm this observation in the tropical soils examined in the Institute.

Samples of diseased soils collected both in Jamaica and Trinidad frequently contain micro-organisms yielding antibiotic substances active against fungi or against fungi and gram negative and gram positive bacteria. One antibiotic has now been purified to some extent by Dr. Forsyth and consists of an amorphous powder of apparent homogenity and high activity. In dilutions of less than one part in a million it arrests the growth of most fungi so far examined. It fails to arrest the growth of both gram positive and gram negative bacteria in dilutions of one part in four hundred.

From *Fusarium* infected soils other antibiotic substances related to the antibiotic Litmacidin and produced by chromogenic actinomycetes have been isolated.

(d) *Miscellaneous Investigations. Mauritius.* At the request of distillers in Mauritius, who were dissatisfied with their yield of rum, samples of yeast were examined. These were found to contain, in addition to yeast, various organisms which were likely to interfere with the normal processes of fermentation. The active yeasts were tested at the Institute and cultures were despatched to Mauritius with details for their cultivation on a laboratory and on a technical scale.

Seychelles. In the Seychelles spontaneously fermenting coconut sap is added to the dough in bread making. At the request of the Director of

Agriculture samples of this sap were examined in the Institute and from these a typical *Saccharomyces cerevisiae* was separated. This was tried in a Trinidad bakery for its dough raising properties and found to be satisfactory. Cultures were sent to the Seychelles with advice for their large scale cultivation in the absence of modern equipment.

Trinidad. During the year negotiations have been proceeding with one of the large local bakeries for the production in Trinidad of a white wheaten loaf supplemented with 2 per cent. of food yeast. It is hoped with the assistance of the Trinidad Government to bring this loaf on to the market very shortly.

APPENDIX I

List of Publications

Papers Published

The Terpenes. Volume 11. By J. L. Simonsen. Revised Edition by J. L. Simonsen and L. N. Owen. Cambridge University Press.

Agricultural Products and the Chemical Industry. By J. L. Simonsen. Address at the Colloquium on "The Industrial Utilisation of Agricultural Products and Seaweed" held in Dublin 2nd and 3rd July, 1947, under the auspices of the Irish Chemical Society and the Royal Institute of Chemistry (Dublin Section).

Colonial Products Research Council. By J. L. Simonsen. *Suomen Kemistilehti,* 1948, A.*21,* 133-138.

The Colonial Microbiological Research Institute, Port of Spain, Trinidad, British West Indies. *Nature,* 1948, *162,* 14.

The Colonial Microbiological Research Institute, Trinidad. By J. L. Simonsen. *Nature,* 1948, *162,* 498-499.

Sesquiterpene Ketones. By J. L. Simonsen. *Suomen Kemistilehti,* 1948, A, *21,* 153-164.

Some Aspects of Terpene Chemistry. By L. N. Owen and J. L. Simonsen. *Endeavour,* 1949, *8,* 26-31.

Einar Christian Saxtorph Biilmann, 1873-1946. By Stig Veibel and J. L. Simonsen. *Journal of the Chemical Society,* 1949, 534-535.

Anhydrides of Polyhydric Alcohols. Part X. The Conversion of Glucamine into 1:4-Anhydro Sorbitol. The Constitution of Monobenzylidene 1:4-Anhydro Sorbitol. By V. G. Bashford and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 299-303.

Anhydrides of Polyhydric Alcohols. Part XI. On the Action of Phosphorus Tribromide on 1:4-3:6-Dianhydro Mannitol and Sorbitol. Some Chloro Derivatives of 1:4-3:6-Dianhydro Sorbitol. By W. G. Overend, R. Montgomery and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 2201-2203.

Anhydrides of Polyhydric Alcohols. Part XII. The Reaction between Mannitol and Hydrochloric acid. By R. Montgomery and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 2204-2208.

Ethylidene Derivatives of Sorbitol. By E. J. Bourne and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 1933-1936.

Conversion of Sucrose into Pyridazine Derivatives, Part III. Constitutional Studies on the Products of Chlorination of 2:6-Dimethyl 3-Pyridazone. By R. F. Homer, Hilda Gregory and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 2191-2194.

Conversion of Sucrose ito Pyridazine Derivatives. Part IV. Further Sulphanilamido Derivatives from 6-Methyl Pyridazone. By R. F. Homer, Hilda Gregory, W. G. Overend and L. F. Wiggins. *Journal of the Chemical Society,* 1949, 2195-2199.

Conversion of Sucrose into Pyridazine Derivatives. Part V. Experiments on the Synthesis of 3-Amino 6-Methyl Pyridazine and its Sulphanilamido Derivatives. By Hilda Gregory, W. G. Overend and L. F. Wiggins. *Journal of the Chemical Society,* 1948, 2199-2201.

Coconut Flavours from Levulinic Acid. By L. F. Wiggins and W. G. Overend. *Manufacturing Chemist,* 1948, *19,* 369.

Photochemical Degradation of Starch. By S. Peat, E. J. Bourne and W. J. Whelan. *Nature,* 1948, *161,* 762.

The Amylolytic Degradation of Starch. A Revision of the Hypothesis of Sensitisation. By E. J. Bourne, W. N. Haworth, A. Macey and S. Peat. *Journal of the Chemical Society*, 1948, 924-930.

Thymol and Cyclohexanol as Fractionating Agents for Starch. By E. J. Bourne, G. H. Donnison, W. N. Haworth and S. Peat. *Journal of the Chemical Society*, 1948, 1687.

The Fractionation of Potato Starch by means of Aluminium Hydroxide. By E. J. Bourne, G. H. Donnison, S. Peat and W. J. Whelan. *Journal of the Chemical Society*, 1949, 1-5.

The Amylose Component of Waxy Maize Starch. By E. J. Bourne and S. Peat. *Journal of the Chemical Society*, 1949, 5-9.

The Component Acids and Glycerides of West Indian *Citrus* Oils. By H. C. Dunn, T. P. Hilditch and J. P. Riley. *Journal of the Society of Chemical Industry*, 1948, *67*, 199-203.

Cottonseed: a Pioneer Crop and an Example. By T. P. Hilditch. *Nature*, 1948, *162*, 832.

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Current work at the University of Liverpool on Potential Sources of Drying Oils. By T. P. Hilditch. *Journal of the Oil and Colour Chemists' Association*, 1949, *32*, 5-23.

Triterpene Acids. By S. C. Bhattacharyya and B. Lythgoe. *Nature*, 1949, *163*, 259.

Cemtelloside. By B. Lythgoe and S. Tripett. *Nature*, 1949, *163*, 259.

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

Production of a Metallurgical Coke from the Resin of Wallaba Wood (*Eperua falcata* Aubl.). By R. H. Farmer and W. G. Campbell. *Journal of the Society of Chemical Industry*, 1948, *67*, 233-234.

Composition of the Gum of *Sterculia setigera*: Occurrence of D-Tagatose in Nature. By E. L. Hirst, L. Hough and J. K. N. Jones. *Nature*, 1949, *163*, 177.

Alkyl Naphthalenes, Part II. The Methyl, Ethyl and N-Propyl Naphthalenes. By J. C. Smith, S. H. Morrell and G. B. Pickering. *Journal of the Institute of Petroleum*, 1948, 34, 677-691.

The Inhibition of *Fusarium oxysporum* var. *cubense* by Musarin, an Antibiotic produced by Meredith's Actinomycete. By H. R. V. Arnstein, A. H. Cook and M. S. Lacey. *Journal of General Microbiology*, 1948, *2*, 111-122.

The Micromanipulator and Its Use. By A. C. Thaysen. *Journal of the Incorporated Brewers' Guild*, 1948, Vol. 34, 267-271.

Papers in the Press

The Sugar Cane as a Source of Materials for Chemical Industry. By L. F. Wiggins. *Journal of the Society of Chemical Industry.*

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

Anhydrides of Polyhydric Alcohols. By L. F. Wiggins. Advances in Carbohydrate Chemistry, Vol. V.

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

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.*

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

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

The Conversion of Mannitol and Sorbitol into Dulcitol. By P. Bladen, L. N. Owen, W. G. Overend and L. F. Wiggins. *Nature.*

The Conversion of 1:4-3:6-Dinahydromannitol and Sorbitol into 1:4-3:6-Dinahydro-L-iditol by the Deamination of the corresponding 2:5-Diamino Derivatives. By V. G. Bashford and L. F. Wiggins. *Nature.*

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.*

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.*

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.*

Drying Oils with Reference to Core-bonding. By T. P. Hilditch. British Iron and Steel Research Association.

African Drying Oils. II. Niger Seed Oil. By H. C. Dunn and T. P. Hilditch. *Journal of the Society of Chemical Industry.*

African Drying Oils. III. Safflower Seed Oil. By C. Barker and T. P. Hilditch. *Journal of the Society of Chemical Industry.*

African Drying Oils. IV. Sunflower Seed Oils. By C. Barker, A. Crossley and T. P. Hilditch. *Journal of the Society of Chemical Industry.*

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 Chemical Industry.*

Isolation of a Saponin from the wood of the Mora Tree (*Mora excelsa*). By R. H. Farmer and W. G. Campbell. *Nature.*

Striga hemonthica. By A. R. Todd, R. Brown, A. W. Johnson and E. Robinson. *Proceedings of the Royal Society.*

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.

The Terpenes. Volume III. By J. L. Simonsen. Revised Edition by J. L. Simonsen and D. H. R. Barton. Cambridge University Press.

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

APPENDIX II

List of Patents

Patents Granted

Improvements relating to the Manufacture of Alkyl and Alkenyl Ethers of Dianhydrides of Hexahydric Alcohols. W. N. Haworth and L. F. Wiggins. B.P. 599,048 (1945).

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 (1945).

Preparation of Acrylic and Methacrylic Resinoid Derivatives. W. N. Haworth, Hilda Daniels and L. F. Wiggins. B.P. 586,141 (1944).

Improvements relating to the Manufacture of Levulinic Acid. W. N. Haworth and L. F. Wiggins. B.P. 583,533 (1944).

Improvements relating to the Manufacture of 5-Hydroxymethyl Furfural and Levulinic Acid. W. N. Haworth and L. F. Wiggins. B.P. 591,858 (1944).

Patent Applications

Manufacture of Analgesics from Pyridazine and Pyridazone Derivatives. W. N. Haworth and L. F. Wiggins. No. 33482/1948.

Improvements relating to Synthetic Resins and Articles made therefrom. J. Osborne and L. F. Wiggins, No. 19408/1948.

Colonial Social Science Research Council Fifth Annual Report (1948-1949)

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

10th May, 1949.

SIR,

I have the honour, on behalf of the Colonial Social Science Research Council, to transmit to you the fifth report of the Council, covering the period from 1st April, 1948, to 31st March, 1949.

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

The Right Honourable A. Creech Jones, P.C., M.P.,
Secretary of State for the Colonies.

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

Membership

SIR ALEXANDER CARR-SAUNDERS, M.A., LL.D., Litt.D., F.B.A., Director, London School of Economics, *Chairman.*

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

PROFESSOR RAYMOND FIRTH, M.A., Ph.D., Professor of Anthropology, University of London.

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

MISS MARGERY PERHAM, C.B.E., M.A., Fellow of Nuffield College, and formerly Reader in Colonial Administration, University of Oxford.

PROFESSOR SIR ARNOLD PLANT, Sir Ernest Cassel Professor of Commerce, University of London.

DR. MARGARET READ, C.B.E., M.A., Ph.D., Reader in Education and Head of Colonial Department, Institute of Education, University of London.

DR. AUDREY RICHARDS, M.A., Ph.D., Reader in Anthropology, University of London.

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

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

MR. P. H. CANHAM, *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
FIFTH ANNUAL REPORT

CONTENTS

COLONIAL
SOCIAL SCIENCE RESEARCH COUNCIL
FIFTH ANNUAL REPORT

I. INTRODUCTORY

1. The Council held 11 meetings during the year 1st April, 1948 to 31st March, 1949.

2. The sudden and tragic death, in October, of Dr. W. T. S. Stallybrass was a severe loss to the Council. Dr. Stallybrass occupied an unique and authoritative position in the field of Colonial Studies, and it will be difficult adequately to fill the vacancy in the Council which his death has caused.

II. GENERAL

3. During the year under review the Council has continued to give much thought to the two problems that constantly arise in the planning of social science research in the Colonies; the problem of providing organisations capable of planning and conducting research in the Colonies themselves, and the problem of securing a number of suitably qualified research workers sufficient to make a reasonable impression on the formidable mass of research projects now listed for priority treatment.

4. The Council is confident that the solution to the first of these problems lies in the creation of regional Institutes of Social and Economic Research, though it is aware that a good case can be made out for the additional creation (at any rate as an interim measure) by Colonial Governments themselves of small Government departments or research branches charged with the task of investigating the many specific administrative problems, sudh as land tenure, native law, etc, that demand urgent remedies. The present position regarding these regional Institutes is outlined below in paragraphs 7 to 10.

5. The perennial problem of research staff has received at least some temporary alleviation in the fulfilment of the scheme for post-graduate social science research studentships that was mentioned in the Council's report for 1947-48. These studentships are tenable at a University in the United Kingdom for a period of from six to twelve months and are designed to equip the student, who must have a good degree (not necessarily in one of the social sciences) and show aptitude for research with the necessary techniques required for the undertaking of a research project in the Colonial field. On satisfactory completion of this preliminary training, the student is required by the Secretary of State to undertake a specific priority research project, of about two years' duration, in one or other of the Colonial territories. These studentships are not confined to applicants from the British Commonwealth and the first award was in fact given to an applicant from the Netherlands. The 12 studentships provided under this scheme have now been awarded. One of the students is already in the field (Mr. Gulliver: see paragraph 23 below). Three are being trained for anthropological studies in East Africa, and four for socio-economic surveys in West Africa. Two will shortly be going out to undertake sociological studies in the Far East. One student has had unfortunately to be invalided home after a short period in the field. And one student will start his training in October, 1949.

6. During the year the Council also recommended that an endeavour be made to secure the services on Colonial social science research of American anthropologists and sociologists. A scheme has now been approved which provides the funds to enable a small number of such American social

scientists to pursue a six months' preliminary course of study at a University or similar institution in the United Kingdom preparatory to the undertaking of a research project, probably in Africa. Candidates for these awards are expected to have obtained a good degree in which sociology or anthropology figure as major subjects and to have done some post-graduate work in these studies, not necessarily in the field, which has demonstrated an aptitude for research. Four studentships have so far been awarded, and the first holder of one of these awards is now doing his preliminary course at University College, London. Further applications are receiving consideration under this scheme, which must however still be regarded as a " pilot " scheme of an experimental nature.

III. INSTITUTES OF SOCIAL AND ECONOMIC RESEARCH

7. The first regional Institute of Social and Economic Research to be established in a Colonial territory is that at Makerere in Uganda. Its first Director, Dr. W. E. H. Stanner, was appointed in the autumn of 1947. To the Council's great regret Dr. Stanner has recently tendered his resignation, for personal reasons, and plans for the development of this Institute are now necessarily in abeyance pending the selection of a successor. During the nine months he spent in East Africa, however, Dr. Stanner was able to make a thorough survey of the physical and organisational requirements for the Institute's establishment, and also made an extensive tour throughout Uganda and Tanganyika to survey the research needs of these territories. Dr. Stanner had just, at the close of the year under review, submitted lengthy reports on the Institute itself and on the social science research requirements of Uganda and Tanganyika. These reports will be of great value to the Council in the reconsideration of the plans for this Institute which is now necessary.

8. The establishment of a similar Institute in the West Indies was foreshadowed in the Council's report for 1947-48. This Institute has now been established and Dr. H. Dudley Huggins appointed as its first Director. Dr. Huggins, who is a Jamaican and previously occupied the post of Agricultural Economist in the service of the Government of Jamaica, came to London for consultations with the Council during the autumn and helped to prepare a five-year budget for the Institute's establishment and maintenance. It has been decided that the Institute should be closely integrated with the University College of the West Indies and that its Governing Body should be that of the University College itself. Dr. Huggins has now returned to Jamaica to superintend the erection of buildings for the Institute and to draw up a programme of research which the Council will have the opportunity of scrutinising. It is hoped eventually to recruit a staff of seven research officers for the Institute and advertisements have been published inviting application for these appointments.

9. A third Institute of Social and Economic Research is proposed for Nigeria, to serve West Africa, and it is expected that this Institute will be integrated with the University College at Ibadan in the same manner as that adopted for the other two Institutes. Advertisements inviting applications for the post of Director have been published, and the Council hopes to be able to proceed to the selection of a Director very shortly.

10. Mention must be made here of the activities of the Rhodes-Livingstone Institute which, although an independent body not created under the Council's auspices, is the recipient (on the Council's recommendation) of grants from Colonial Development and Welfare Research funds, and is in many important respects the prototype of a Colonial Social Science Research Institute to

which the Council hopes the other Institutes will conform. The Rhodes-Livingstone Institute, under its new Director (Dr. Edith Colson), has continued during the year the research activities which have gained it a very considerable reputation in academic circles all over the world and with Colonial Administrations. Towards the end of the year the Chairman of the Board of Trustees (Sir Gilbert Rennie, Governor of Northern Rhodesia) submitted a stimulating and ambitious programme of social science research activities to be undertaken during the next five years, involving expenditure of the order of £134,000. This programme is now being revised but the Council hopes to have the opportunity of discussing it in the very near future.

IV. SOCIAL SCIENCE RESEARCH PROJECTS IN PROGRESS

(Those marked with an asterisk are new projects undertaken on the Council's recommendation during the year under review.)

A. Africa

11. *Ethnographic Survey of Africa.* Dr. Meinhard is at present in East Africa examining documents in Government and Mission files, assisted by Mrs. Meinhard, and has found a considerable quantity of very valuable material. Eleven sections of the Survey are now ready for publication: Ibo, Ibibio, Yoruba, Nupe, Tiv, Akan, Ga, Mole-Dagbane and three sections on the Rhodesias.

12. *Handbook of African Languages.* Four publications have already been produced:—

(i) Bantu Lexicographical, Bibliographical and Phonetic Studies since 1860—by Professor C. M. Doke.

(ii) The Classification of the Banty Languages—by Dr. Malcolm Guthrie.

(iii) The Distribution of the Semitic and Cushitic Languages of Africa—by M. A. Bryan.

(iv) The Distribution of the Nilotic and Nilo-Hamitic Languages of Africa—by M. A. Bryan, with linguistic analyses by Dr. A. N. Tucker.

Three volumes of the projected four volumes of a "Survey of the Languages of Africa" will be ready for the press during 1949, as well as special studies by Professor Westermann, Professor Lukas and Mr. R. C. Stevenson.

13. *Survey of Northern Bantu Linguistic Border.* The four members (one Belgian, one French and two British) of the international research team which is to undertake this project are at present working at the School of Oriental and African Studies. They are expected to leave for Africa early in June 1949 and to remain in the field until October 1950. The scheme is being jointly financed from the Colonial Development and Welfare Research allocation and by the French and Belgian Governments, and is being supervised by Dr. A. N. Tucker and Dr. Malcolm Guthrie.

14. *Study of African Marriage Customs.* The Executive Committee has now held three meetings. The Committee has Sir John Waddington as its Chairman and consists of representatives of all bodies interested in this research project. Of the research staff, Mr. Arthur Phillips has been working on Belgian and French Government and documentary material; Dr. Lucy Mair, assisted by Miss Levin, has been examining published anthropological material on Central, South and West Africa; and the Reverend Lyndon Harries has been scrutinising records at Edinburgh House. It is hoped to have the Report ready in 1950.

15. *Psychological aptitude testing in Nigeria.** This new project is being undertaken by Dr. Geoffrey Tooth who recently completed two years' research work in the Gold Coast and submitted valuable reports on (*a*) Juvenile Delinquency, (b) Mental Changes in Trypanosomiasis, and (*c*) Mental Illness in the Gold Coast. Dr. Tooth's enquiries in Nigeria will be limited at first to an investigation into the use of tests for the selection of candidates for Nigerian Government Technical Institutes and Trade Schools. At a later stage it may be possible for him to extend his investigations to the problem of the selection of candidates for other institutions, such as the University College, and for certain Government appointments. His work will in many ways be complementary to that being done by Mr. Bedell and Mr. Deans Peggs in the West Indies (see paragraph 34 below) and is expected to produce results that will be of considerable scientific interest as well as of immediate practical value to the Nigerian Government.

16. *Secondary School Science Teaching in Nigeria.* Mr. Smithies' investigation, started during the previous year, is now nearly complete and his Report is expected shortly.

17. *Linguistic Research, Gold Coast.* Mr. Berry has returned from his field work in the Gold Coast where he investigated problems of the Adangme language. He has now resumed his lectureship at the School of Oriental and African Studies but will, in his spare time, be writing up his material for publication. Mr. K. C. Whittaker's research work on problems of the Akan group of languages, to assist him in which a research grant was given him to purchase recording apparatus, is still continuing.

18. *Socio-Economic Study of the Krobo people, Gold Coast.** The Council was happy to further the policy of encouraging Colonial University staff to pursue research in the time they can spare from their teaching duties by recommending the provision of a grant for anthropological field work by Mr. K. T. S. Baldwin of the University College of the Gold Coast. It is considered that a study of this people, about whom very little printed material is available, will constitute a useful addition to knowledge.

19. *Historical Research, Gold Coast.** The opportunity for historical research in Africa is practically unlimited. In this respect the Gold Coast may appear to offer a narrower field than some other British African Colonies, having already inspired two major histories: by Claridge and by Ward. But there is still ample room for scientific historical investigation and the Council had no hesitation in sponsoring Miss Freda Wolfson for the undertaking of a study of the history of British Relations with the Gold Coast during the nineteenth century. Miss Wolfson spent some five months in the Gold Coast in the year under review, during which she travelled extensively, visiting the large number of places of historical interest and examining the considerable quantity of archives that the Gold Coast Government has recently taken very active steps to assemble and preserve. It is hoped that Miss Wolfson will be able to pay another visit to the Gold Coast in pursuit of original material in the course of the next few months. Apart from its scientific value, her work may be expected to throw light on the strong nationalistic feeling in the Colony that was so much evident during the unfortunate disturbances that arose last year. Miss Wolfson's study will also form an interesting sequel to Mrs. Meyerowitz' study of the role of gold in the art and culture in the Gold Coast, mentioned in last year's report, which has now been written up and will shortly be published under the title: "The Sacred State of the Akan."

20. *Anthropological Research on the Mende, Sierra Leone.* On the recommendation of the Council, an invitation has been sent to Dr. S. Hofstra,

Director of the Prins Hendrik Museum in Rotterdam, to spend two months in London during the summer term working on the Mende field material he collected in Sierra Leone just before the war, in association with the School of Oriental and African Studies. The Council feels that this material can be adequately worked up for publication in English during a visit of this kind, and that the product will be of considerable value to anthropologists and to the Government of Sierra Leone.

21. *Political Organisation of Typical Communities in the Gambia.* Mr. D. P. Gamble's Colonial Research Fellowship has been extended until September this year to enable him to complete his field investigations and to give him a period in this country in which to write up his material. Mr. Gamble is expected to return from the Gambia in April.

22. *Anthropological Study of the Kisii, Kenya.* During the year Dr. U. P. Mayer returned to Kenya for a further period of field work, in which he is being assisted by Mrs. Mayer. Dr. Mayer has already written two long papers with the material he has collected, on Kisii Lineage and Kisii Bride-wealth, and publication of these reports is now being arranged.

23. *Anthropological Study of the Turkana, Kenya.** This new project is one of the first field studies to be undertaken by a holder of a post-graduate studentship in social science research to which reference is made in paragraph 5 above. The Turkana tribe has never been scientifically studied and Mr. Gulliver's study of this nomadic people will fill an important gap in anthropological knowledge.

24. *Research into East African Music.* This project, the only one of its kind so far sponsored by the Council, still continues under the direction of Dr. Klaus Wachsmann, Curator of the Uganda Museum. The scheme will expire during the current year. The material collected is likely to be of practical value for linguistic studies as well as of great interest to musicians and educationists.

25. *Translation of Paulitschke's "Ethnographie Nord-Ost Afrikas."* This translation is being done by Miss Edith Cory with the assistance of the International African Institute. It is not yet complete.

26. *Social Survey of Zanzibar.* No report is yet available of the results of this experiment for an intensive social survey using scientific sampling technique. The team of field investigators is working under the direction of Professor Edmund Batson, Dean of the Faculty of Social Science in the University of Cape Town.

27. *Psychological Studies in Northern Rhodesia and Nyasaland.* Mr. M. G. Marwick's investigations among the Cewa and Ngoni are still continuing during the time he can spare, principally in the vacations, from his duties as a member of the staff of Fort Hare. Mr. Marwick published in the 1948 issue of *Theoria* a paper entitled "African Witchcraft and Anxiety Load," and another on the Bwanali-Mpulumutsi anti-witchcraft movement will be published shortly.

28. *Study of administration by Native Authorities in Nyasaland.** This study by Dr. Lucy Mair, originally planned for 1948, had to be postponed and is now to be undertaken during the period April-September, 1949. The object of the enquiry is to investigate the effectiveness of the indigenous political institution as an agency of modern government, particularly in relation to development and welfare activities. The study will include an examination of available official records and a period spent at the head-quarters of a selected Native Authority.

29. *Native Land Tenure in Basutoland.* Mr. V. G. J. Sheddick is still engaged on the collection of material in the field.

B. Far East

30. *Teaching of Malay in English Schools in Malaya.* This educational research project, undertaken by Miss M. B. Lewis of the School of Oriental and African Studies, has now been completed. Her report has been mimeographed and a large number of copies sent to Malaya for distribution in educational circles.

31. *Anthropological Studies in Sarawak.** Four anthropological research projects were put in hand in this Colony during the year under review. The first is a study of the problems relating to the Chinese communities, and is being undertaken by Mr. Ju-K'ang T'ien. The second is a study by Mr. W. R. Geddes of a Land Dayak community which owing to close economic contact with other alien culture groups is in a state of social stress: a community, based primarily but not exclusively on dry rice cultivation, in which land shortage is imminent. The third is of a traditionally based stable Iban community not subject to undue land shortage. In this the research worker, Mr. J. D. Freeman, is being assisted by his wife who will also be collecting anthropometric data. The fourth study, by Mr. H. S. Morris, is of a "Malay" community primarily engaged on the production of sago by traditional methods. All these studies are being undertaken as a result of the recommendations made by Dr. E. R. Leach in his "Report on the Possibilities of a Social and Economic Survey of Sarawak." It will be recalled that this Report is the result of the visit made to Sarawak by Dr. Leach in 1947 on the Council's recommendation.

32. *Anthropological Studies in Singapore.** Towards the end of the year Mr. M. Freeman and Mrs. Freeman (Miss Judith Djamour) began studies in Singapore of Chinese family structure and of Malay family structure respectively. The general nature of these studies is described in Professor Raymond Firth's Report on Social Science Research in Malaya mention of which is made in paragraph 37 below. Mr. and Mrs. Freeman are being given generous assistance by the Singapore Department of Social Welfare whose recently published "Social Survey of Singapore" contains a great quantity of valuable sociological information and has been warmly welcomed by the Council as a most useful and praiseworthy contribution to the study of Colonial urban communities.

C. Pacific

33. *Linguistic Research in Fiji.* Mr. G. B. Milner has made steady progress in his study of the Fijian language. His research grant, on the Council's recommendation and with the warm support of the Government of Fiji and the School of Oriental and African Studies, has now been extended for a further year for the following purposes: (*a*) to investigate the Nadroga and Nadi dialects of Viti Levu and possibly also the Ra dialect, (*b*) to visit Tonga for a preliminary study of Tongan, (*c*) to begin the study of the Melanesian languages of the Solomon islands.

D. West Indies

34. *Psychological Research.* Mr. B. J. Bedell (in Trinidad) and Mr. Deans Peggs (in Jamaica) are continuing their investigations of the mental ability of the West Indian child. Both research projects will be complete this year.

35. *Social Survey of Jamaica.* This team project, under the direction of Miss Edith Clarke, is now nearing its conclusion and it is hoped that preliminary reports will be available by the end of the year.

36. *Study of Friendly Societies.* Mr. A. F. Wells has already submitted three lengthy interim reports on the Friendly Societies of Barbados, Trinidad and Jamaica. Further reports are expected in the course of the next few months on the Societies in British Guiana and the Windward Islands. Mr. Wells is expected to return to the United Kingdom in September, 1949.

V. PUBLICATIONS

37. The following are the major social science research studies published during the year with assistance from the Colonial Development and Welfare Research allocation:—

(i) Bantu Prophets in South Africa.
Dr. B. G. M. Sundkler (Lutterworth Press).

(ii) A Demographic Survey of the British Colonial Empire (Volume I, West Africa).
Dr. R. R. Kuczynski (Royal Institute of International Affairs, Oxford University Press).

(iii) African Labour Efficiency Survey. (Colonial Research Publications No. 3 H.M. Stationery Office.)
Dr. C. H. Northcott, Director.

(iv) Some Problems of Anthropological Research in Kenya Colony.
Professor I. Schapera. (International African Institute, Oxford University Press.)

(v) Social Science Research in Malaya (Government Press, Singapore).
Professor Raymond Firth.

38. The following major social science research studies were also received during the year, and their publication is now under consideration:—

(i) The Social and Political Organisation of the Nandi.
G. W. D. Huntingford.

(ii) The Sacred State of the Akan.
Mrs. Eva Meyerowitz.

(iii) Municipal Government in Kenya.
Miss Mary Parker.

(iv) Mental changes in Trypanosomiasis.
Dr. Geoffrey Tooth.

(v) Mental Illness in the Gold Coast.
Dr. Geoffrey Tooth.

VI. REORGANISATION

39. Towards the end of the year under review the Council considered proposals for the reorganisation of its own activities. These proposals are still being examined, but it is possible that the Council will shortly establish standing Committees each of which will deal with a group of the social science subjects that come within the Council's terms of reference. These Committees would then replace the existing standing committees formed on a geographical basis.

Colonial Medical Research Committee Fourth Annual Report (1948-1949)

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

13th June, 1949.

Sir,

On behalf of the Colonial Medical Research Committee, I have the honour to transmit to you the Fourth Annual Report of the Committee, covering the period 1st April, 1948, to 31st March, 1949.

I have the honour to be,
Sir,
Your obedient Servant,

E. MELLANBY
(Chairman)

The Right Honourable A. Creech-Jones, M.P.,
Secretary of State for the Colonies.

COLONIAL MEDICAL RESEARCH COMMITTEE

Membership

Sir EDWARD MELLANBY, G.B.E., K.C.B., M.D., F.R.C.P., F.R.S., Secretary, Medical Research Council, *Chairman.*

Brigadier J. S. K. BOYD, O.B.E., M.B., 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.

Dr. A. N. DRURY, C.B.E., M.D., F.R.S., Director, Lister Institute of Preventive Medicine.

Brigadier N. HAMILTON FAIRLEY, C.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., 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.

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

FOURTH ANNUAL REPORT

CONTENTS

COLONIAL
MEDICAL RESEARCH COMMITTEE
FOURTH ANNUAL REPORT

GENERAL

1. Four meetings of the Committee and eight meetings of Sub-Committees were held during the year. In the temporary absence of Professor N. Hamilton Fairley his place was taken by Professor G. Macdonald; Professor P. A. Buxton acted as Chairman of the Malaria Sub-Committee and Dr. A. F. Mahaffy as Chairman of the Helminthiasis Sub-Committee.

2. The Committee learnt with regret of the resignation of Dr. A. F. Mahaffy of his appointment of Joint Secretary and Director of Medical Research from the end of March, 1949. His place is being taken by Dr. Lewthwaite whose research work in Malaya is well known.

COLONIAL RESEARCH SERVICE

3. The preparation of terms of service and scales of remuneration was completed during the year and the proposals have been circulated to all Colonial Governments for their consideration. Colonial Governments have also been asked to consider proposals for a Colonial superannuation scheme. It is hoped that these consultations will soon be completed. In the meantime all engagements of research workers have had to be made on contract terms.

WORK OF THE COMMITTEE

4. The various research projects and organizations which had been initiated or supported by the Committee continued in progress during the year and were dealt with by the appropriate Sub-Committees. These included:—

The Nutrition Research Station and Field Working Party in the Gambia.
The East African Medical Survey.
The Virus Research Institutes at Entebbe and Lagos.
Malaria Research in North Borneo, Malaya and East Africa.
Research on Scrub-Typhus in Malaya.
Physiological research at Makerere College, Uganda.
Research on Hot Climate Physiology in Nigeria.
Research on Relapsing Fever in Kenya.

Two new research projects were taken up and approved during the year and preliminary arrangements were made for their development. These were for research on (i) Bancroftian filariasis and onchocerciasis in East Africa and (ii) loiasis in the Cameroons. Work on the former scheme has already been initiated by a team under the Medical Research Council. Other schemes brought forward towards the end of the year were for (i) investigations on field rodents in East Africa in relation to communicable disease and (ii) research in digestive function in malnutritional conditions in Uganda. As the cost of these additional projects could not be met from Colonial Development and Welfare funds the Medical Research Council has undertaken to carry them out.

5. Members of the Committee and of Sub-Committees visited several territories. Professor B. S. Platt paid three visits to the Gambia to supervise and take an active part in the nutrition research work there. Dr. F. Hawking, with a Medical Research Council team, spent six months in East Africa for studies on the chemotherapy of filariasis and onchocerciasis, and

reported on the suitable arrangements for future work on filariasis in the area, which it is intended should be undertaken by a Colonial Office team. Professor R. M. Gordon, a member of the Helminthiasis Sub-Committee, visited Nigeria and the Cameroons at the request of the Committee to advise on the organization for research on loiasis there. Professor P. A. Buxton in the course of a visit to West Africa and the Belgian Congo had opportunities of contact with research workers on various other subjects. The following members of the Committee and Sub-Committees attended the International Congress on Tropical Medicine and Malariology in Washington, U.S.A. in May, 1948; Brigadier J. S. K. Boyd, Professor P. A. Buxton, Major-General Sir Gordon Covell, Professor G. Macdonald, Professor B. G. Maegraith, Dr. A. F. Mahaffy.

6. Sir Edward Mellanby paid a visit to the Union of South Africa in October-November, 1948, to see the research activities in progress there, some of which will be of special importance in relation to the general development of medical research in Africa. The Committee, at the request of the Colonial Office, submitted their advice on the medical subjects which they considered suitable for inclusion in the Agenda of a Scientific Conference on Regional Research in Africa which it is proposed to hold at Johannesburg in the autumn of 1949 and also suggested the names of suitable representatives from the United Kingdom, for medical subjects. Amongst those recommended as specially suitable for research on a regional basis were tuberculosis and venereal diseases, in view of the varying characteristics of these conditions in different areas and their importance in many territories.

7. In the previous year the Committee had considered the question of carrying out in Africa trials of the value of B.C.G. vaccine in the prevention of tuberculosis, but had postponed action in view of work that was being undertaken on the preparation of a stable freeze-dried vaccine that might possibly be suitable for central manufacture and subsequent distribution for use in the field. A preparation retaining full original potency has not yet been obtained and distribution by air of the freshly prepared vaccine, or local manufacture, will be necessary if trials are to be undertaken. B.C.G. is being used on a very large scale in many parts of the world, including the French and Belgian African territories, but controlled trials in Africa are not being undertaken which might provide an estimate of its value in the conditions prevailing there. The Committee consider that these should now be undertaken in a selected area, with a stable population and a known incidence of tuberculosis, and have recommended the appointment of a medical officer to carry them out. A knowledge of the local conditions and language is considered to be essential and an endeavour will be made to obtain an officer from the Medical Service of one of the African Colonies.

East African Bureau of Medical Research

8. The preliminary arrangements for the setting up of this Bureau have been completed and a Director, Dr. K. Martin, has been appointed. It is expected that Dr. Martin, who at present occupies the post of Deputy Director of Medical Services in Kenya, will take up his new duties in the near future. The headquarters of the Bureau will be located in Nairobi, Kenya.

Research Laboratory at Freetown, Sierra Leone

9. Arrangements have been made to take over the laboratory at Freetown, Sierra Leone, from the Liverpool School of Tropical Medicine. The necessary provision has been made to recondition and equip the laboratory and a research programme will be developed there when staff becomes available.

East African Medical Survey

10. Following on the preliminary arrangements for the East African Medical Survey in Sukumaland, an account of which was given in the Report for 1947-48, the Committee deputed Colonel Davidson to visit Tanganyika to discuss how the Survey's project could best be integrated with the Government of Tanganyika's own medical and health scheme, and also to report on the most suitable headquarters for the organisation. Questions of accommodation and personnel were gone into on the spot and the lines discussed on which the successive stages of the scheme would be developed. Colonel Davidson reported to the Survey Sub-Committee and advised that Stage I in the scheme should proceed at once, although the final arrangements as to accommodation and headquarters would require to be further considered. The project was also discussed in detail with Dr. Sneath, D.M.S., Tanganyika, during his visit to the U.K. and an assurance of full co-operation has been given by the Government of Tanganyika. Colonel Davidson was appointed Director of the Survey and proceeded to Tanganyika in December, 1948. Work is now in progress from temporary headquarters and it is likely that the headquarters will eventually be located at Mwanza, where the necessary living and laboratory accommodation will be provided. The additional staff required for the research team is being recruited. The scheme has been designed for the purpose of obtaining a basic knowledge of the vital statistics of an African village population and the conditions affecting health, and subsequent development of a practical public health and medical organisation fitted to the particular circumstances of a selected rural area.

Virus Research Institutes

11. The Virus Institutes in Uganda and Nigeria continue to be financed by grants made by the Rockefeller Foundation and by the Secretary of State for the Colonies under the Colonial Development and Welfare Acts, as well as by contributions from the local Governments concerned. As mentioned in the previous report the Rockefeller Foundation had signified their intention of withdrawing their support at the end of 1948. In view of the difficulty in providing and housing new staff they have, however, agreed to continue their participation in the work of the Institutes until the end of 1949. Adequate housing accommodation is now available at both Institutes and good progress has been made in recruiting staff for the Uganda Institute. The staff position at the Institute in Nigeria is less satisfactory but every attempt is being made to solve this problem before the end of 1949.

Research on Hot Climate Physiology

12. The programme of research in Hot Climate Physiology is being developed under the direction of Dr. W. S. S. Ladell who is at present employed by the Nigerian Government as lecturer in bio-chemistry at the Yaba Medical School. Housing and laboratory accommodation have been made available at Oshodi near Yaba, and the work of equipping the laboratory is nearing completion. Dr. Ladell attended the Fourth International Congress on Tropical Medicine and Malaria in Washington in May, 1945, and following leave in the United Kingdom, returned to Nigeria in September. During his absence the development work at Oshodi was supervised by a laboratory technician who was appointed on the recommendation of the Committee. It is anticipated that a full-time research officer will join Dr. Ladell's staff as soon as a suitable candidate can be found for this post.

REVIEW OF THE WORK IN PROGRESS

Malaria

13. *North Borneo :* Research on malaria in North Borneo by the team under Dr. J. McArthur was continued during the year, Mr. D. H. Colless, the entomologist of the team, taking charge during a period of absence of Dr. McArthur on sick leave. The work has mainly consisted of the study of the different vector species in Borneo in relation to application of methods of control.

Dr. McArthur had incriminated *A. leucosphyrus* as the important vector in the interior of the country and in proximity to jungle. The species is one which breeds mainly in small pools in hillside creek-beds usually under fairly dense shade and it had been shown in the previous years at Sandakan that effective control could be obtained by limited jungle clearing. To determine whether the method is suitable for application throughout jungle areas of Borneo an experiment is being conducted in a limited area at Tumbunan in the Timban valley, difficult of access and with a stable population, where *A. leucosphyrus* is also the presumed vector. As records over a period of 12 years show a spleen rate approximating 100 per cent. with little variation, any effect of control measures should be readily demonstrated. Some of the trained staff who were engaged in the clearing work at Sandakan will be employed in the Tumbunan experiment; the results will be awaited with interest.

14. Studies in vector species were carried out in several areas by Mr. Colless. Investigations in the Lajan-Bukit Kudu hyperendemic area showed *A. leucosphyrus* to be the effective vector there, a high level of gut and salivary gland infection being demonstrated. A study of the distribution and intensity of malaria and of the possible vectors in the Seria and Miri oilfields was also carried out. In these areas malaria appears to be hypo-endemic with periods of high epidemic prevalence. The role of two species, *A. umbrosus* and *A. sundaicus,* required to be considered and it appears likely that the former may be concerned in maintaining a low level of endemicity and the latter a main vector during periods of epidemic prevalence. The subject is considered to need further study. *A. leucosphyrus* does not play any important part in transmission in the oilfields areas. Mr. Colless has continued a general study of the systematics and bionomics of the anophelines of Borneo.

15. The arrangements for the formation of headquarters and laboratory of the team at Labuan were completed during the year and it is now satisfactorily established and equipped. Dr. McArthur's extensive memoir on his studies on malaria in Borneo has been duplicated for distribution.

16. *Malaya:* Dr. Field, Dr. Strahan and Dr. Edeson continued their studies on the chemotherapy of malaria in Malaya under a grant from Colonial Development and Welfare Funds and submitted a second interim report on the results to the Committee.

17. Trials of the prophylactic value of Paludrine (proguanil), mepacrine and chloroquine were undertaken in the labour forces of plantations in an endemic area, the population of which would be expected to possess some degree of immunity. The suppressive value of the drugs was not severely tested as malaria transmission was comparatively light during the period, but with due reservation on that account it was considered that the high suppressive value of Paludrine in *falciparum* and *vivax* malaria had been confirmed. In the particular conditions prevailing little difference was shown in the results with single weekly doses of 100 mg. to 300 mg. Paludrine. A single weekly dose of 300 mg. mepacrine was less effective than the same dose of Paludrine, but chloroquine in a weekly dose of 250 mg. gave slightly

better results than Paludrine at the same level. An occasional breakthrough occurred with all drugs at all dosages used. A marked reduction in spleen size was noted when prophylactic use of any of the drugs was regular.

18. Single-dose or single-day therapy of the overt attack was tried, a comparison being made between Paludrine and mepacrine. The dosages used were single doses of 100 mg. or 300 mg. Paludrine and single doses of 300 mg. or total dosage of 600 mg. mepacrine in the day. The results with Paludrine were satisfactory and the disappearance of parasitaemia was quicker with that drug in *falciparum* malaria than with mepacrine although the duration of fever was somewhat longer. As some of the cases treated with mepacrine still showed parasites seven days later it is concluded that a single dose of 300 mg. mepacrine is not efficient. In *vivax* and quartan malaria infections the action of mepacrine both on parasitaemia and fever was quicker than that of Paludrine. Some cases of grave falciparum infections were treated with Paludrine acetate or lactate parenterally but as no controls with quinine or mepacrine were available no conclusions can be drawn from the results. A case showing parasitaemia exceeding 500,000/cm. recovered. No significant toxic effects of any of the drugs used was observed.

19. Further work in single-dose therapy is planned, including trials with chloroquine, in view of the likely practical value of the method in rural areas. It is also intended to compare the results obtained in control of malaria by (*a*) D.D.T. or gammexane spraying of houses and (*b*) the use of Paludrine prophylaxis, in selected areas. The Colonial Insecticides Committee will be concerned with the work on the former measure.

20. *East Africa:* Dr. R. C. Muirhead Thomson completed his investigations on *A. gambiae* in Dar-es-Salaam during the year and returned to the United Kingdom in October, 1948. The problems chiefly studied were (*a*) the status of salt-water *A. gambia* in East Africa and its role in transmission of malaria and (*b*) the behaviour of *A. gambiae* in houses in relation to control by residual insecticides.

Salt-water *gambiae* was found to be indistinguishable from fresh-water *gambiae* in the adult, larval and egg stage, thereby differing from West African salt-water breeder, *A. melas,* in which eggs and larvae are different from those of typical *gambiae.* To distinguish wild-caught females of the two forms in East Africa it was necessary to induce females to lay eggs in captivity; when the eggs hatched the larvae of the two forms showed a sharp physiological difference in reaction when exposed to sudden changes in salinity. This physiological difference formed the basis of all work on incidence of the two forms in village houses, on feeding and resting habits, and on natural infections with malaria parasites. In the same village, during 1947 and 1948, the sporozoite rate of fresh-water *gambiae* females was 9.4 per cent., compared with 0.8 per cent. for salt-water *gambiae,* showing that typical *gambiae* is much the more efficient vector of the two, and as far as Dar-es-Salaam is concerned much more important than salt-water *gambiae* in numbers as well as infectivity On the other hand the salt-water form may be rather more important as a vector of filaria larvae, as it showed an infection rate of 15 per cent. in 1947. Studies on the salinity tolerance of salt-water *gambiae* larvae showed that continuous breeding is not possible when the salinity exceeds about 80 per cent. sea water. It is suggested therefore that control of all anopheline breeding, fresh-water *gambiae, funestus,* and salt-water *gambiae,* in two extensive fresh-water swamps south of Dar-es-Salaam harbour might be achieved by letting the sea water in and increasing the salinity of the swamps above that critical point.

21. Previous work in West Africa had provided a simple but efficient method of studying the effects of residual insecticides on anopheles in African houses. It had revealed that *gambiae* may escape unharmed from houses treated with D.D.T. in kerosene. This technique was applied in Dar-es-Salaam to compare accurately the effects of D.D.T. dispersible powder with those of Gammexane dispersible powder, P.530. The results show clearly that a high proportion of *gambiae* can escape unharmed from a hut treated with twice the normal dose of D.D.T. The same dosage of Gammexane proved almost completely lethal to *gambiae* for at least three months after treatment, during which time numbers of dead *gambiae* could be taken at every collection, and there was no indication of mosquitoes escaping unharmed from the treated hut. It was concluded by Dr. Muirhead Thomson that Gammexane dispersible powder was the most promising residual insecticide against adult *A. gambiae* so far.

22. *Recommendations on the use of proguanil (Paludrine).* The Malaria Sub-Committee had under continuous consideration the question of the most suitable methods of use of proguanil (Paludrine) in prophylaxis and treatment of malaria. Evidence from the results of extensive field trials, and of clinical experience in different parts of the world, was available, but certain additional information on the action of the drug on African strains was required, in view of some unsatisfactory reports on the results of its use in that Continent. The establishment of a West African strain of *P. falciparum* at the Ministry of Health's Malaria Laboratory, Horton Hospital, Epsom, for which an efficient vector (*A. stephensii*) had been found, enabled experimental studies on prophylaxis and treatment to be carried out there, on human subjects requiring malaria treatment. The work was undertaken by Major-General Sir Gordon Covell, Mr. P. G. Shute and Miss Maryon along with the staff of the hospital and the results were reported to the Malaria Sub-Committee. The high prophylactic value of proguanil was confirmed in tests with the strain but radical cure was not obtained by a course of treatment consisting of two doses of 300 mg. proguanil daily for ten days, cases relapsing within a short period of the termination of treatment. Clinical response to treatment was slow, as has frequently been noted with this drug. When, however, the course was supplemented by three doses of 300 mg. mepacrine or three doses of 10 grains of quinine on the first day of treatment only, relapse did not occur and the duration of fever was shortened. The effective gametocidal action of proguanil was demonstrated during the tests. It is apparent from the results of the investigations that, while proguanil alone may produce radical cure of *falciparum* malaria in some cases, it cannot always be relied upon to do so, and the Malaria Sub-Committee have accordingly recommended the trial of the reinforced method in the field for the purpose of obtaining information on its value under practical conditions, as a guide to future practice.

23. The recommendations eventually drafted by the Sub-Committee specified a prophylactic regimen and courses aiming at cure, and also methods for prophylaxis and treatment which would be practicable in application to semi-immune populations in endemic areas of malaria. These have been issued by the Colonial Office and the Medical Research Council on the advice of the Colonial Medical Research Committee and are given below. It should be clearly appreciated that the recommendations are tentative on the basis of present knowledge and are subject to review in the light of future experience and experiment.

Prophylactic use

The dose recommended for suppression of malaria, of all types, in endemic areas, is 100 mg. daily.

For children the following dosage is advised:—

From birth to 5 years of age	25 mg. daily.
From 6 years to 12 years of age	50 mg. daily.

When a daily dose is not practicable one dose of 300 mg. should be taken on the same day each week: dosage for children should be in the above proportion.

In the case of persons (other than the indigenous inhabitants) who have been resident in an endemic area for some time, or who have been otherwise already exposed to malarial infection, a full therapeutic course (see 1 (a) below) should be taken before entering on the suppressive regimen of Paludrine.

Therapeutic use

1. *P. falciparum (malignant tertian) infections; mixed infections; undiagnosed type infections.*

(a) *For treatment of non-immunes.*

Paludrine alone cannot be relied upon to effect radical cure in all cases, and the clinical response with this drug unaided is also somewhat slow. It has been shown, however, that these disadvantages may be overcome by reinforcement with mepacrine on the first day of treatment. The following combined course is recommended *for trial:*

300 mg. Paludrine twice daily for 10 days, reinforced on the first day of treatment with three doses of 300 mg. mepacrine, and followed by 100 mg. Paludrine daily for six weeks.

(Persons continuing to live in an endemic area should continue their suppressive regimen.)

(b) *For treatment of the clinical attack in semi-immune subjects such as labour forces and rural populations in endemic areas.*

A single dose of 300 mg. Paludrine will usually suffice to produce clinical cure. Relapses can be treated similarly as and when they arise. Serious cases should be given emergent treatment (see below).

(c) *For treatment of malarial "emergencies".*

For treatment of emergent conditions such as cerebral or algid malaria and where for any other reason the patient is unable to take drugs by the mouth, immediate intramuscular mepacrine or intravenous quinine therapy should be employed.

2. *P. vivax (benign tertian) infections.*

(a) *With the object of radical cure.*

The course advised for adults is 100 mg. Paludrine plus 10 mg. pamaquin base (or a corresponding dose of one of the other 8-amino-quinoline derivatives) three times daily for 10 days. The dose for children should be proportionate.

Pamaquin should not be given unless the patient can be kept in bed under medical supervision throughout the course; this is particularly important in the case of children. When the patient cannot be kept in bed the alternative course recommended is 100 mg. Paludrine three times daily for 10 days followed by a single dose of 300 mg. Paludrine on the same day each week for a year.

(b) *For treatment of the clinical attack in semi-immunes.*
As for M.T. malaria.

Unless otherwise stated, the dosage mentioned is that for adults.

In recommending the use of a single dose of 300 mg. Paludrine for the treatment of the febrile attack in semi-immunes and a weekly dose of 300 mg. for suppressive purposes, the advantages of these procedures are emphasised as (*a*) bringing an effective anti-malaria drug with the economic capacity of village and rural populations of endemic areas of malaria and (*b*) providing a method of prophylaxis easy of administration.

Nutrition.

24. Work on nutrition, of which a detailed review was given in last year's report, has been continued by the staff of the central organisation—in the Human Nutrition Research Unit of the Medical Research Council, at the Field Research Station which has been established at Fajara in the Gambia by the Medical Research Council with the assistance of funds made available under the Colonial Development and Welfare Acts, by the Nutrition Field Working Party at Genieri (also in the Gambia) and in the Department of Nutrition at the London School of Hygiene and Tropical Medicine. The inter-relationship of various aspects of the research work, especially on the medical side, has become clearer during the past year as a result of field surveys in the Gambian villages and the preliminary work at Fajara, and it is now possible to re-orientate investigations at the Human Nutrition Research Unit so that they shall assist with the elucidation of the problems emerging from the work in the Gambia. A review of the Unit's work is given in the reports of the Medical Research Council in which are included lists of publications by members of the Unit staff. Work on the reconditioning, rebuilding and equipping of the station is almost complete. The additional building-space which, as noted in last year's report, was needed to provide facilities for scientists specialising in subjects only indirectly related to nutrition has been taken over and suitably equipped, and is almost ready for occupation; this apart from one ward of sixteen beds that is reserved for nutritional studies, and has been open throughout the year. Senior members of the staff of the Human Nutrition Research Unit are now engaged in the Gambia on work on the clinical aspects of the researches which they have been making at the Unit in recent years.

25. The clinical investigations have been principally concerned with the prevalent types of anaemia, with liver pathology and oedema; work has continued with a view to determining the extent to which these conditions are dependent on malnutrition and on zymotic disease. The results of surveys in the villages as well as the preliminary results of investigations at Fajara appear to show that evidences of protein deficiency are common, and the extent to which these are the result of infections and infestations is being investigated. Measurements have been made of the "energy cost" of various rural activities and attention is being given to the effects thereon of the state of health and nutrition of the worker. A study of the digestion and absorption of Gambian cereals as traditionally prepared has been begun as part of an investigation into the nutritional value of home-processed and mechanically milled grain products.

26. The recent survey by the Nutrition Field Working Party at Genieri was extended in the spring of 1949 to another village where milk and meat are eaten, and it now includes two more villages where conditions are sufficiently similar to those originally existing at Genieri for them to serve as a current control. The striking increases in the body weights of Genieri villagers, attributable to a greater supply of staple cereal which has been

available in the past year, have been accompanied by an increased prevalence of signs of insufficiency of the accessory food factors, for it has been impossible in the one year to balance the diet at the higher level of consumption by an increased production of vegetable crops, a step which is proposed for the 1950 agricultural season. One of the main features of the year at Genieri has been the increase of land under crops which has been made possible by the introduction of modern agricultural implements. During this year seventy-nine Genieri farmers worked, as a combined operation with the Working Party, an area of land in addition to that normally cropped. This land was planted with groundnuts, using modern machinery and other services for which cash was paid, and the net return from the enterprise, which was determined by analysis of the costings records by the Agricultural Economics Research Institute at Oxford, has been put aside by the farmers to open a Post Office Savings Bank Account. An important measure of the attitude of the villagers has been the increased number of Genieri farmers willing to take part in the combined effort—108 men during the coming year as against 79 in 1948-49—and only four men in the village now remain outside the scheme.

27. The African's aptitude and ability to undertake farming by modern means and to operate machinery are being studied; surveys are being made as a basis for the beginning of other improvements, such as housebuilding, and the development of improved skills, and some simple technical operations have already been introduced.

28. With the assistance of a firm of milling machine manufacturers trials have been made of equipment for a mill for common tropical cereal grains. It is proposed to set up a mill of sufficient size to serve a group of villages; comparable area services are the workshop already set up by the Gambia Agricultural Department for work on agricultural machinery and the School which has been started in a village adjacent to Genieri. This experiment in applied nutrition at Genieri was studied during a visit by the Senior Nutrition Officer, Institute for Medical Research, Malaya, Dr. R. C. Burgess, with a view to initiating a project on similar lines in the Far East. The report of the Department of Nutrition in the London School of Hygiene and Tropical Medicine (Annual Report of the London School of Hygiene and Tropical Medicine 1947-1948) will be found to supplement the above statement.

29. Members of the staff of this department have materially assisted with the work in the Gambia. They also conducted, with the assistance of Mr. K. Hunt of the Agricultural Economics Research Institute, a Nutrition School at Makerere, Uganda, in February, 1949, with a view to stimulating interest in the problems of nutrition in colonial territories. This School was attended by teams, comprising medical, administrative and agricultural officers and social welfare and education workers, from Kenya, Tanganyika, Northern Rhodesia, the Sudan and the Seychelles.

Helminthiasis

(a) *Filariasis*

30. *W. bancrofti and O. volvulus infections.* Fundamental studies on the chemotherapy of filariasis have been in progress for several years at the National Institute for Medical Research, using cotton rats infected with *Litomosoides carinii* as experimental animals. Very many compounds have been examined for therapeutic activity. The new antifilarial drug Hetrazan had been investigated by Dr. F. Hawking, who had found that it is very active in removing microfilariae from the blood stream; the observations made suggest that the drug sensitises the microfilariae so that they are seized and destroyed by the phagocytes of the reticulo-endothelial system.

As a preliminary to long-term investigations on filarial infections in East Africa, the Medical Research Council despatched a research team to Tanganyika to undertake field studies on the effect of Hetrazan. Dr. F. Hawking and Lt.-Col. W. Laurie established temporary headquarters at Tanga in October, 1948, where laboratory and hospital facilities were provided by the Medical Department. Cases of *bancrofti* infections were placed under treatment with courses of Hetrazan, at different levels of dosage and for varying periods, to determine the most suitable methods of use of the drug. A very rapid disappearance of circulating microfilariae was noted, but in a proportion of cases a few persisted at a low level. The action of Hetrazan on *Mf. bancrofti* in man seemed to depend on the same processes as in experimental animals. Cases have been placed under treatment at a number of centres in different parts of Tanganyika living under conditions in which continuous observation can be carried out, and a long-term follow-up will be made to ascertain the permanency of the result of treatment. Direct observation of the effect of Hetrazan on the adult forms of *W. bancrofti* is difficult, since they are usually situated deep in the tissues; but the adult forms of *Onchocerca volvulus* are more superficially situated and are readily accessible to biopsy. Dr. Hawking accordingly extended his investigations by a visit to Jinja, where onchocerciasis is prevalent, in order to examine adult worms after treatment. A report on the findings in both types of infection will be published later.

31. Dr. Hawking and Lt.-Col. Laurie had been asked by the Colonial Medical Research Committee to report on the facilities available for research in filariasis in East Africa and to advise on the most suitable centre and the organization required for the more extended investigation under the Colonial Office which is proposed. Mwanza has been selected as the headquarters of a Colonial Office team, of which Lt.-Col. Laurie will be in charge, on termination of the Medical Research Council's work, to carry out research on all aspects of filarial disease in the area, including methods of control. Mwanza presents special facilities for the purpose as isolated populations of suitable size are available in islands in Lake Victoria for the observation of the effects of control measures. Onchocerca-infected areas will be accessible at Jinja, Uganda, in which that type of infection can also be studied, and it may be important to deal with a possible risk of spread of onchocerciasis in connection with the proposed hydro-electric scheme on the White Nile. An additional medical officer, an entomologist, a helminthologist, a field officer and laboratory technicians are being recruited to staff the team.

32. *Loiasis.* Professor R. M. Gordon of the Liverpool School of Tropical Medicine visited the Cameroons on behalf of the Committee and submitted a report on the facilities available for undertaking research on loiasis, with his recommendations on the suitable organization, staff and accommodation for the purpose. His proposals were approved and the work will be undertaken at Kumba where there is a high level of infection. Preliminary observations were made on the breeding of Chrysops in the area and the study of its bionomics and the methods applicable for its control will form an important part of the proposed investigations. The field work will be commenced in June, 1949, and Mr. Crewe, who has been studying Chrysops in Professor Gordon's Department, will be accompanied at first by Dr. Kershaw and possibly by Professor Gordon himself for a period. It is hoped that a member of the staff of the British Museum will also be able to take part in the work later on. A medical officer will be recruited as permanent head of the team and will be given an opportunity of some special training in the Department of Entomology and Parasitology of the

Liverpool School. He will also undertake chemotherapeutic trials in the Cameroons. It is recognised that much basic work is still required on filarial disease and the association of the loiasis team with the Liverpool School of Tropical Medicine will be valuable.

(b) *Schistosomiasis.*

33. As research on schistosomiasis is being undertaken in Egypt by the Medical Research Council and is also being carried out in Southern Rhodesia by Dr. D. M. Blair and his colleagues, it has not been considered necessary to undertake work on the subject in Colonial Territories at present. Members of the Committee are, however, in close touch with the work of the Medical Research Council team and will be in a position to advise on an application of the findings to Colonial Territories or on the extension of work in other areas.

Dr. Newsome and Dr. Cowper, who formerly worked under the Colonial Office, have continued their work on schistosomiasis in Cairo during the year in close association with members of the staff of the Egyptian Ministry of Public Health and have had the advantage of using the facilities of the Bilharzia Snail Destruction Centre and the Fuad 1st Research Institute and of having access to numbers of bilharzia cases in hospitals and jails. Their work has been largely on the chemotherapy of the disease. On the basis of previous observations on the blood levels of Miracil D, obtained by different dosages of the drug, courses of treatment have been framed and tested on groups of patients, with control by examination of the urine for ova and a follow-up for six months. Progress has also been followed by complement fixation tests with the sera of the treated cases. A level for total dosage, administered over a varying number of days, has been fixed which will be tolerated by the majority of patients.

34. Marked clinical improvement is obtained by the use of a suitable course but complete sterilization does not appear to be obtained as a rule in Egyptian patients. The drug has unfortunately been found in Egypt to be irritant to the gastro-intestinal mucosa, although it does not produce any other detectable damage. This irritant action of Miracil D appears likely to militate against the general use of the drug in Egypt, especially under field conditions, and the production of a preparation of less irritant character seems desirable. It is understood that work on the subject is in progress in several laboratories.

A laboratory test has been developed by means of which the effective concentration of a drug, known to be active against bilharzia, can be ascertained. This consists in determining the action of different concentrations of the drug on the adult schistosomes in serum culture. The results obtained with Miracil D corresponded closely with the indications obtained in clinical trials. The action of certain amino-acridines has also been tested by the method and they have been found to be lethal to the schistosomes at levels very similar to that of Miracil D. They have unfortunately the disadvantage that they are rapidly excreted, and it would not be likely that an adequate concentration could be maintained in the blood. Others of the series are being tested and also some diamidine compounds and other drugs.

35. As experience with Miracil D in Southern Rhodesia had been reported to be more favourable than in Egypt, Dr. Newsome, from Cairo, visited Salisbury to confer with Dr. Blair and his colleagues who had been carrying out trials with Miracil D of the same batches as used by himself. There appears to be no doubt that cure of urinary bilharzia infections is obtained in Southern Rhodesia in a very large proportion of cases with dosage even less than had been used in Cairo. This difference has been attributed to a much

lower level of infection existing in Southern Rhodesia as compared with Egypt. The African in Southern Rhodesia also appeared to stand the irritant action of the drug better. An indication has thus been obtained that local conditions may affect considerably the treatment of schistosomiasis in different parts of Africa or in Colonial Territories elsewhere. The above findings refer to *haematobium* infections. *S. mansoni* on the other hand appears to be less affected by the dosage of Miracil D which produces clinical improvement or cure of the urinary infection due to *S. haematobium.* Further work on *mansoni* infections is required and if a suitable area can be found in Egypt in which *mansoni* is the prevailing form the work will be undertaken there. As the result of the meeting of workers on schistosomiasis in Salisbury a programme for future comparative investigation has been drawn up.

36. Infections in experimental animals have been maintained in Cairo in relation to different lines of study and material has been provided for the preparation of diagnostic antigens. Studies in the pathology of bilharzia disease are being undertaken and for the purpose the M.R.C. team has been strengthened. Monkeys have been imported from Eritrea on which the pathological and histological changes due to experimental bilhanzia infection of different degrees will be investigated, including the possible occurrence of cancerous conditions such as malignant papilloma.

Virus Diseases

37. The Virus Institutes in Nigeria and Uganda continue to be primarily concerned with a study of the epidemiology of yellow fever. The work in Bwamba County, Uganda, has been continued and has produced results of considerable significance. Similar studies were carried out in selected areas in Nigeria. In addition to the work in yellow fever the causative viruses of other diseases were studied when time permitted.

As mentioned in the last report work in Bwamba County had provided evidence that yellow fever in that area is essentially a disease of the monkeys of the forest, and that it is able to maintain itself indefinitely in these animals without in any way being dependent on the presence of human infection. The vector responsible for the transmission of infection from animal to animal was however still unknown although the evidence strongly suggested that the tree-haunting species *Aedes* (*Stegomyia*) *africanus,* Theo. was the most likely culprit. During 1948 a focus of sylvan yellow fever was located through the employment of rhesus monkeys stationed as ' sentinels ' in the canopy of the uninhabited Bwamba forest. During the course of this outbreak yellow fever virus was repeatedly isolated from *Aedes africanus* captured in the infected forest area while all attempts to recover virus from other species of mosquitos failed. These results of this important study showed quite conclusively that *Aedes africanus* was the vector of prime importance in an outbreak of sylvan yellow fever in Bwamba.

The studies which have been made in Uganda have provided convincing evidence that there exists in Africa an epidemiological type of yellow fever which is strictly analogous to the jungle yellow fever of South America. Although this type of yellow fever became known only comparatively recently it is now believed that it may well be the original epidemiological type of the disease. It is now thought that the permanent reservoir of virus which exists in the animals and in the mosquitoes of the forest is the ultimate source of the much longer known classical yellow fever of urban communities.

The detailed results of investigations on various aspects of the yellow fever problem as well as on the viruses of Rift Valley Fever and Mengo encephalomyelitis will be found in a series of articles which have been published or submitted for publication during the year.

The Scrub-Typhus Research Unit in Malaya

38. The mission of the Unit is to make a long-term study of the natural history of scrub-typhus by investigating the biology and ecology of carrier mites, and also of their animal hosts, of which rats are the most important. The ecological study of rats is being pursued with wider issues in mind. When, during the recent Japanese war, this disease caused some 25,000 British and American casualties, the need for counter-measures became urgent. It was then apparent that, in spite of much valuable earlier investigation by workers in Japan, Malaya, the Netherlands-Indies and Australia, all too often burdened with other problems, many large lacunae existed in the sum of available knowledge. Intensive concerted investigation by experimental epidemiologist and entomologist was clearly required. Late in 1944 the Typhus Committee of the Medical Research Council and the War Office had established a scrub typhus Field Laboratory at Imphal in Assam; and interesting preliminary findings had been obtained. It was with the object of maintaining continuity with this work that the present Research Unit was raised, equipped and sent to Malaya, with headquarters at the Institute for Medical Research, Kuala Lumpur. The Unit comprises three scientists, by training and experience specially apt for the work in hand. Dr. J. R. Audy, in charge of the Unit, had previously commanded the military field laboratory at Imphal; he is responsible for mite taxonomy and ecology, and the general epidemiological aspects of the enquiry. Mr. K. L. Cockings, also formerly with the Imphal team, is collecting and breeding mites; and, in conjunction with Dr. S. R. Savoor, the Senior Pathologist of the Institute, is attempting infection of mites (bred in the laboratory through the life cycle) with laboratory strains of scrub-typhus. Mr. J. L. Harrison, D.Sc., is responsible for the vertebrate zoology.

39. In brief, the general ecological problem may be stated in the following question. What is the relationship borne by scrub-typhus to limited patches of terrain? How do hyperendemic areas develop and what opportunities does this disease have of becoming more widespread and well-established both within and outside its present area of distribution? What should be the long-term policy of control? These broad questions are raised because evidence gathered during the recent war showed that hyperendemic scrub-typhus is largely a man-made disease like epidemic plague or urban yellow fever, and has definite potentialities for spread. These problems involve investigations in several narrower fields, such as identification, and the study of the distribution of mites and their hosts, the ecology of mites in the soil, and the assessment, in proper perspective, of the acquisition of infection by mites either congenitally or by feeding on infected hosts. Interesting results have already been obtained, for a complete account of which the reader is referred to the Annual Report of the Institute for Medical Research for 1948, where detail is given of the collections made of animals and parasites, mostly rodents and insectivores. In this phase of the investigation the American Scrub-typhus Research Unit, now at the Institute, has collaborated closely (vide infra).

40. The vexed question of taxonomy is receiving much attention. Trombiculid mites of at least 24 species (possibly seven new) have been encountered. Since the earlier pioneer work of Gater (1928-1932) at the Institute, much progress has been achieved in the systematics of the trombiculid mites. Gater's view that *Trombicula deliensis* (Walch) may be only a sub-species of *Trombicula akamushi* (Brumpt) has gained strong support by the discovery of intermediate forms. Mr. H. Wolmersley, of the South Australian Museum, the foremost authority on the trombiculid mites of the Oriental and Australasian regions, is completing an important monograph on these.

The Unit is collaborating with him in the study of the Malayan forms. Included in this work is the correlation of larvae and adults by breeding. Many of the difficulties of the breeding of trombiculae in the tropics have been surmounted by refinements of technique relating to moisture, the size of soil particles used and the accessibility of food. Emergent larvae are fed on white mice; the nymphs and adults on mosquito eggs. The growth of fungi has been minimised by alkalinisation with magnesia. A pure strain of *T. deliensis* is now established. The life history of rats has received special attention. From examination of specimens trapped, observation of rats in cages, and from baiting and marking of wild rats, information is being collected about the length of life, mortality and fecundity of various species. There appears to be a distinct seasonal variation in fecundity of town rats, but as yet there is insufficient information about forest species.

Nine papers have been published or are in the press. Throughout, close contact has been maintained with the U.S. Scrub-typhus Research Unit, the entomologist and parasitologist (Col. C. B. Philip and Major R. Traub) of which had considerable experience of scrub-typhus during the Japanese war; especially was this so in the field prophylaxis trials of Chloromycetin (vide infra).

Chloromycetin in Scrub-Typhus and Typhoid Fever.

41. During the period under review an investigation into the curative effect of a new antibiotic drug, chloromycetin, by an American research unit based on the Institute for Medical Research in Malaya yielded results of far-reaching importance, to layman and scientist alike. This investigation was not initiated by the Colonial Medical Research Committee, insomuch as it derived from very recent American laboratory work on an American drug, and from proposals based thereon from an American source. But for various reasons that will become evident as the report proceeds, it is considered expedient to record it here. The Committee was kept informed of its progress at all stages, and individual members evinced the greatest interest in it. Moreover, as previously noted, the British scrub-typhus epidemiological unit participated in certain field aspects of the chloromycetin work, especially during the months between the departure of the American unit from Malaya and its return; while at certain points in the enquiry the staffs of the Divisions of Bacteriology and Pathology materially assisted.

As stated earlier, scrub-typhus had taken heavy toll of the allied forces during the Japanese war. Its menace remained, both to British and American forces still on garrison duties in the Far East and to the planting community in Malaya and adjacent territories.

42. When, therefore, in November, 1947, the Commandant of the U.S. Army Medical Department Research and Graduate School, Washington, submitted protocols of preliminary laboratory experiments that augured well for eventual success, and enquired whether a U.S. Army research unit might have the opportunity to collaborate with the staff of the Institute in trials of chloromycetin, at that time barely known, the offer was warmly welcomed by the Director of the Institute (Dr. R. Lewthwaite), and by the Government of Malaya. The factors that attracted this research unit to Malaya and its Institute are succinctly expressed in the following extract from the Annual Report for 1948-49 of the Commission of Immunization of the U.S. Army Epidemiological Board: "Malaya provided an ideal place for the clinical trial of chloromycetin in the treatment of one of the rickettsial infections of man, i.e., scrub-typhus. Here there were available: (1) considerable concentrations of patients, (2) suitable hospital facilities, (3) proper laboratory facilities, and (4) groups of scientific investigators and physicians who had

demonstrated their interest in scrub-typhus over a period of years by contributing the major portion of the fundamental knowledge regarding this disease which had been published in the English medical literature."

In March, 1948, the unit arrived by special plane with two tons of equipment and the world supply of chloromycetin, viz., 1 lb. With five members, each of high calibre, the unit comprised two virus workers, a physician, and two experienced entomologists and epidemiologists—namely Dr. Joseph E. Smadel, Captain Herbert, L. Ley, Dr. Theodore E. Woodward, Colonel Cornelius B. Philip, and Major Robert Traub.

43. *The drug chloromycetin.* Medical research workers in Britain and the U.S.A., especially the research divisions of the large biological business houses, had not been slow to explore further the new paths of advance in curative medicine that had been opened up by the war-time efforts of British and American investigators of penicillin. Strains of moulds by their thousands were tested. In 1947 Dr. Paul R. Burkholder, a botanist of Yale University, U.S.A., experimented with a mould collected from soil in Venezuela; and from it isolated an extract that showed anti-bacterial properties. It was referred by him to the Research Laboratories of Parke Davis & Co., Detroit and named "Chloromycetin". Subjected there to preliminary trials in test-tube and laboratory animal, its range of action was further explored, and methods for its quantitative estimation in blood were devised. An early finding was the protection given by it to chick embryos infected with the causal Rickettsial organisms of louse-borne typhus, i.e., the "classical" devastating form of typhus. The drug was thereupon referred to Dr. Joseph E. Smadel, Head of the Department of Virus and Rickettsial Diseases, Army Medical School, Washington, D.C., and one of America's leading virus experts, for additional laboratory trials, primarily against the viral and Rickettsia agents. The investigations of the Army Medical School showed that the protective properties of the drug extended to most of the rickettsial agents, including the causal organism of scrub-typhus and of certain virus infections; and (of prime importance) that its toxicity to animals, including man, was low. A short visit to Mexico by Dr. Smadel and Lieut. Ley in January, 1948, confirmed, in a small series, that the drug was effective in man against louse-borne typhus.

44. *The Course of the Investigation.* Within twenty-four hours of reaching Kuala Lumpur Dr. Smadel and his colleagues had settled into the laboratories set aside for them at the Institute for Medical Research, and the treatment of three early cases of scrub-typhus had begun. Two days later all three patients had normal temperatures, toxicity had vanished, and convalescence was well on the way. When contrasted with the known severity of the disease in untreated cases, viz., the 15 days (or more) of fever, the severe toxicity, and the liability to grave complications affecting lung and nervous system, it was evident thus early in the investigation that the success in the laboratory was being fully reproduced in man; that in chloromycetin the physician now had at his disposal a powerful curative agent against scrub-typhus.

Favoured by an explosive outbreak of the disease on an estate near Kuala Lumpur, some 40 proven cases were treated with the drug in the next ten weeks, without a failure, by the physician of the U.S. Unit, Dr. Theodore E. Woodward, Associate Professor of Medicine, University of Maryland, U.S.A. Since in untreated cases death may occur from the twelfth day of fever onwards, the importance of early diagnosis is clear. Yet some amongst the 40 were first treated as late as the eighth day, and one notable case on the ninth day. At the time of writing approximately 90 cases have been treated, all successfully. The drug is given by mouth, in tablet or

capsule form. In the first few patients treatment continued for several days, but it soon became clear that one day's administration sufficed in most cases.

45. July, 1948, marked an event of the utmost significance; for in that month the investigators in Kuala Lumpur received from the Research Division of Messrs. Parke, Davis and Company 11.25 gm. of the drug, barely sufficient for two cases, that had been prepared by chemical synthesis. Preliminary trials of the product in eggs and mice in Dr. Smadel's laboratory in Washington had given every expectation that human trials would succeed. Two Gurkha soldiers, infected during jungle warfare against bandits, were selected; in one the infection was very severe, in the other it was moderately severe. They were treated with the synthetic drug on the 5th and 6th days of the febrile reaction respectively. In both the temperature reached normal within 48 hours and remained so; toxicity vanished and convalescence was uneventful.

46. *Typhoid Fever:* Among the cases treated were several febrile patients in whom the clinical picture did not entirely conform to that of scrub-typhus, and who, as expected, proved by laboratory tests to have typhoid fever. They were nevertheless treated with chloromycetin by Dr. Woodward; the results on the first ten have already been the subject of a preliminary report. In brief it may be said that improvement of the general condition and diminished toxicity usually became apparent within 24 hours after treatment began. The temperatures fell to normal levels within four days; and though occasionally relapses occurred, these responded promptly to a second course of the drug.

47. The above is but a brief narrative of the early major events as they unfolded. As in most research projects, new paths of investigation presented themselves as progress was made. Thus the infallibility of the drug in the treatment of scrub-typhus made it possible deliberately to expose groups of human volunteers in known infested areas of countryside, a procedure hitherto denied by the considerable death-rate of the untreated disease. Hyper-infested areas of countryside were selected according to the tally of the vector-mites, *Tr. akamushi* and *Tr. deliensis,* found on captive white rats exposed for one or more days. Under the dynamic direction of Dr. Smadel considerable strides were made in the study of the chemoprophylactic potentialities of the drug, a matter of obvious importance to troops, planters, survey parties, forest officials, and the like.

48. This American Unit left Malaya in August. The potentialities of the collaboration were far from exhausted; much remained to be investigated, and Dr. Smadel's proposals for the joint-enquiry to be continued found ready acceptance in America and Malaya. In November, 1948, the American Unit, modified in composition, returned to the Institute for a further six months' study. The possibilities of effective chemoprophylaxis in scrub-typhus by the use of chloromycetin were further probed; three more field experiments utilising human volunteers were made, and yielded data of much promise. Therapeutic studies of scrub-typhus and typhoid fever continued. In the former disease the simplicity of the one-day treatment with 6 gm. of the drug left little scope for refinement. In typhoid fever various modifications of dosage were tried, aiming mainly at simplification. A number of detailed reports are now in the press and record the progress made.

49. By a curious circumstance it was found that chloromycetin is effective against gonorrhoeal urethritis. A volunteer in a field trial in prophylaxis was being given once-weekly doses of 4 gm. of the drug. On a day prior to the giving of one of these doses he reported a profuse urethral discharge,

from which gonococci were isolated. Treatment was withheld for 24 hours by Dr. Charles A. Bailey, the U.S. physician in charge of the case, and thus consisted only of 4 gm. of chloromycetin, taken orally. So effective was the drug that two days later all trace of infection had vanished. As a result of this finding other similar cases of gonococcal infection were sought; and a recent preliminary communication has recorded the successful treatment of 32 cases. That chloromycetin should be effective against the gonococcus is not very surprising, for the organism is susceptible to other antibiotics. The importance of the finding is rather in the fact that the drug is given orally; and that in another disease, scrub-typhus, the drug given orally suppresses that disease at least during the period of its administration. A fruitful field of investigation by venereologists may well have been opened up by this finding.

50. The observations made concerning the therapy and prophylaxis of scrub-typhus, the therapy of typhoid fever and of gonorrhoea, are manifestly of great importance. But perhaps the paramount observations have been of a more general nature, namely, the implications of the successful large-scale synthesis of an effective, non-toxic antibiotic; an advance of knowledge that is unique amongst the many notable findings have marked progress in the field of antibiotic studies. The search by the organic chemist for synthetic closely-related antibiotics will be intensified, in the hope that the spectrum of diseases affected by that class of drug will be widened, and that inevitably reduced costs, approximating perhaps to those of the sulphonomides, will gradually free this and other such antibiotics from the restriction of use imposed by the expense of fermentation methods of preparation. In conclusion, the effectiveness of the collaboration of research workers regardless of frontiers, each worker with a special aptitude for the task in hand, and enabled to concentrate exclusively on that work, could not be better exemplified than by this joint enquiry.

Physiological research at Makerere College, Uganda.

51. *Anaemia.* Dr. Lehmann found the prevailing type of anaemia in the area to be of parasitical and not nutritional origin. There was an iron-deficiency anaemia present due to blood loss in ankylostomiasis. Patients did not recover completely on iron treatment alone and those who recovered to some extent rapidly relapsed on discontinuation of the iron treatment unless hookworm removal was carried out. No nutritional macrocytic anaemia was seen. Macrocytic anaemia and "dual cell" anaemia was found to be the expression of the outpouring of reticulocytes. Reticulocytes are larger than the circulating cells but contain a normal amount of haemoglobin; they are thus macrocytic and (so far as concentration of haemoglobin is concerned) hypochromic. The dual cell type of anaemia occurs when reticulocytes appear on iron treatment of a hookworm anaemia.

52. *Haemoglobin estimations and levels.* A modification of King's cyanhaematin method for warm climates was worked out jointly by Dr. Lehmann and Dr. Baird and the details are being published. The original method was found to lead to turbidities at high temperatures. Haemoglobin levels of adults and children were investigated in homesteads outside Kampala and in school-children. A proportion were found to be anaemic, there being differences at different age-levels. Adults responded to iron treatment but children did not, in some cases, do so until they had been treated with Paludrine. Well nourished East Africans were found to show blood levels comparable with those seen in Europe with a somewhat higher cell count (average 5,800,000) attributed to living at an elevation of 4,000 feet above sea level.

53. *The "sickle cell" trait.* Investigations on this condition were carried out by Dr. Lehmann in association with Mr. Milne and Dr. Raper on about 5,000 persons in relation to tribal and racial origin. The results of the study, which will be published, will contribute usefully to physical anthropology. From the observations made it is considered that the condition that has been described as sickle-cell anaemia can be recognised as being malarial anaemia in persons with the sickle-cell trait.

Kwashiorkor

54. Certain aspects of this condition of malignant malnutrition, which occurs in the area, were studied in adults. Evidence was accumulated that it will be necessary to differentiate carefully between malnutrition, and malnutritional aspect due to parasites. It was found that skin pallor and hair changes can be reversed by hookworm treatment. It was considered that the role of malnutrition can only be small in adults compared with that of parasites as causes of diseases; relatives of patients were found to look well nourished. Preliminary observations on babies on the other hand suggest that Kwashiorkor in them may well be due to dietary causes. Milk is scarce and dear in Uganda and babies who are not nursed up to 2 years of age will find it difficult to obtain a diet sufficiently rich in protein and at the same time easily digestible. Babies are seen to recover on milk administration. The blood condition in these babies will be studied to determine the nature and causation of their anaemia.

Relapsing Fever

55. Dr. G. A. Walton, whose services had been lent by the Sierra Leone Government, commenced investigations on tick-borne relapsing fever in Kenya in May, 1948. The disease is found to be mainly confined to the districts of Meru, Nyeri, Embu and Teita in which the majority of the 2,326 cases reported in the years 1945-48 had occurred. Over large areas of the rest of the colony only a few sporadic outbreaks and occasional itinerant cases have been observed but the exact incidence is not known. A study was first made of incidence in relation to major climatic and physical features, and it was found that the areas associated with relapsing fever are those in the Kenya Highlands at considerable elevation with a mean annual temperature of 65° F. to 70° F., and a rainfall of over 40 inches, occurring in the two periods with dry intervals between. The areas are situated around the bases of high mountains. Investigations on the distribution of *Ornithodorus moubata* were first undertaken in the Embu District at elevations of about 4,000 feet, where numerous huts were examined. In one portion of the district no ticks were found and in another a few huts only were shown to be infested. In a native hotel heavy infestation was found and ticks recovered were proved to be infected. An important stock route ends at the village of Isiara, near the border of the district, and along this native hotels were found to be infested as also the tribal detention huts in Isiara, but not the village huts. The general conditions in Embu District are considered not to be specially suitable for *O. moubata* and it would appear that the occasional infestations which occur will die out unless reinfestation takes place by introduction from Tigania, in a range of hills in the Meru District, where ticks are said to be numerous. The investigations will be extended to other areas.

Preparation of Precipitin Sera.

56. Research on the preparation of precipitin sera for use in the diagnosis of the blood meals of biting insects had been undertaken during the last two years at the Lister Institute at the request of the Committee. A contribution to the cost of the work, which had formerly been borne entirely by the Institute, was made during the year from Colonial Development and Welfare

funds. Considerable advances had been made in obtaining sera of a considerable degree of specificity and, for the purpose of extending the range of species dealt with, arrangements were made for the deputation of Dr. Weitz from the Lister Institute to East Africa. He was able to obtain blood of many additional species for use in raising sera in laboratory animals. Such sera are valuable reagents in epidemiological studies on insect-borne diseases. The investigations are continuing and the question of central preparation for distribution for use in field studies will be considered.

Hot Climate Physiology.

57. A further brief visit by Dr. W. S. S. Ladell was made to Enugu Colliery in January, 1948, since the visit reported last year; conditions in the roads had been much improved by the installation of powerful fans but the air was still stagnant and very hot and humid at the coal-face; the workings in this part of the mines were, however, shortly to be closed down. Detailed observations of working conditions have been made only at the colliery; but preliminary observations have been made in other industries; in particular at Railway Workshops in various parts of Nigeria, at Tin mines, in palm-oil and rubber factories and, by courtesy of the U.A.C., at the sawmill and ply-wood factory at Sapele. Conditions in the printing trade and in locomotive driving have also been observed. The general conclusion reached is that in many industrial occupations conditions could be improved by comparatively simple measures; for example by the installation of exhaust fans or cowls or, in some cases, merely by the elimination of huge expanses of black painted corrugated iron facing the sun. Much could be done to better the working conditions in Nigeria by putting in exhaust-systems to keep down the humidity in enclosed spaces and by the wide use of white paint, especially on sheet-metal walls.

58. African living conditions have been observed in many parts of Nigeria. The outstanding impression was one of low air-movement, especially in sleeping spaces; in part this is due to the great desire for security on the part of the occupiers; many houses are built with the smallest possible windows to keep out intruders. But it is probable that the West African has comfort-standards which differ in certain respects from those of the European. This is also suggested by the tolerance, for example by the Yorubas, of heavy ceremonial clothing. Investigations into this problem are planned. Observations in houses of different types have confirmed the advantage of having a ceiling separating the roof-space from the living quarters; and shown the importance of having this roof-space ventilated. The temperature of the roof-space is lower under cement shingles than under corrugated metal sheets; but corrugated aluminium is cooler than corrugated iron. The coolest roof so far observed was one of thatch covering corrugated aluminium. Some observations still in progress, comparing the micro-climates in quarters identificial except for the presence or absence of mosquito proofing, have shown that in a mosquito-proofed house the temperature does not fall so low at night nor does it rise so high in the afternoon. The slightly cooler temperature in the hottest part of the day is offset to a certain extent by the diminished movement of the air through the building. The smaller daily variation is probably due to the increased resistance to air-flow offered by the mosquito gauze. Suggestions have been made that space-cooling might be effected by means of water which has been cooled by circulation through the subsoil; the temperature of water in deep wells has therefore been measured. Wells have been investigated in districts up to thirty miles inland; the temperature is approximately the same in all cases, varying from 80-81° F. (26.6-27.2° C.); the ambient air in Southern Nigeria is above this for most of the daylight hours, but falls below it at night.

59. The Scheme originally included work on veterinary as well as on human problems. Veterinary stations in various parts of Nigeria have been visited to obtain information as to the way in which farm animals stand up to the heat and humidity of West Africa. The problem of how an animal becomes acclimatized to a tropical climate is in many ways more interesting than the problem of human adaptation; but owing to lack of time and of facilities this side of investigation has not been pursued further.

60. Before Dr. Ladell proceeded on leave in April, 1948, he investigated the effect of small doses of Pituitrin upon the reaction of Africans to moderate heat. His results, which have been published, showed, on statistical analysis, that the group of eight students tested was composed of two sub-groups; the men in one sub-group had high sweat-rates which were reduced by the injection of Pituitrin; and in the other sub-group the men had low sweat-rates which were increased by injecting Pituitrin. Thus without Pituitrin there was a great difference between the sweat-rates of the two sub-groups but after Pituitrin there was no difference.

61. When Dr. Ladell returned from leave late in October, 1948, the Laboratory Superintendent appointed to the scheme had already arrived to take up his duties; and work on the conversion of the R.A.F. buildings at Oshodi to quarters and laboratory was well in hand. The conversion was completed by February, 1949, and the laboratory was immediately taken over. All the Heat Research equipment, the last instalment of which had only arrived in December, 1948, was moved out from the Medical School to Oshodi and further equipment was obtained from the Medical School. In the meantime Dr. Ladell had been carrying on with the field work referred to earlier in this report. In March, 1949, an air-conditioned room was brought into operation and experiments were started in it to determine the best tolerances of Africans at various rates of work. This work will continue throughout the third year of the scheme and will involve not only observation of experimental subjects under controlled conditions of temperature, humidity and air-movement but also the determination of metabolic rates of men at various common occupations; it will also be necessary to examine the diet to a certain extent and to investigate any influence that the time at which main meals are taken may have. Throughout the period of the scheme there has been full liaison with the Ministry of Supply Tropical Testing Establishment at Port Harcourt. The air cooling and drying equipment for the air-conditioned room is on loan from this organisation. The Medical Department of Nigeria has also very generously sanctioned the transfer of certain items of equipment from the Medical School to the Heat Research laboratory. A small meteorological station has been set up on the site, most of the equipment for which has been kindly loaned by the West African Meteorological Service; monthly returns are made to the Nigerian Meteorological Office of the sun-temperature readings taken at the station. Contact has been established with the Army Medical Authorities in Nigeria with a view to the use of army personnel as experimental subjects; the African subjects used so far have been volunteers from men employed in the Unit and some tests have been done on European prisoners in Lagos gaol, who had volunteered as subjects.

Publications

1. "Some physiological observations on West African Coal Miners"—British Journal of Industrial Medicine (1948) 5, 16.

2. "The effect of Pituitrin upon performances in moderate heat"—South African Journal of Medicine Science (1948) 13, 145.

Committee for Colonial Agricultural, Animal Health and Forestry Research Fourth Annual Report (1948-1949)

Royal Botanic Gardens,
Kew, Surrey.
May, 1949.

SIR,

I have the honour, on behalf of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to transmit to you the Fourth Annual Report of the Committee for the year 1948–49.

I have the honour to be,
Sir,
Your most obedient servant,

(Sgd.) E. J. SALISBURY.
(Deputy Chairman)

The Rt. Hon. A. Creech Jones, M.P.,
Secretary of State for the Colonies.

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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 Governmental 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 Appointments Department of the Colonial Office.

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

FOURTH ANNUAL REPORT

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COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH AND FORESTRY RESEARCH

FOURTH ANNUAL REPORT

I. GENERAL

The Committee record with deep regret the death of their Chairman, Sir John Fryer, K.B.E., M.A., F.R.S., on the 22nd November, 1948.

2. During the year Mr. T. Dalling, M.A., M.R.C.V.S., F.R.S.E., Director, Veterinary Laboratory, Ministry of Agriculture and Fisheries, and Dr. C. D. Darlington, D.Sc., F.R.S., Director, John Innes Horticultural Institution, resigned from the Committee on completion of their three-year terms of service. Dr. Bell, Professor Beveridge, Dr. Cheesman and Dr. Hall accepted invitations from the Secretary of State to become members of the Committee for three years. Dr. H. H. Storey, C.M.G., Ph.D., F.R.S., relinquished the duties of Secretary in September, 1948, on appointment as Deputy Director of the East African Agriculture and Forestry Research Organisation. The Committee desire to place on record their appreciation of the valuable services rendered by Dr. Storey and their welcome to Dr. Herklots, who succeeded him on the 1st October, 1948, as Secretary to the Committee and as Secretary for Colonial Agricultural Research.

3. During the year 1948-49 the Committee held six meetings. The activities of the Sub-Committees covering research on cocoa, stored products and soils are recorded in their separate reports which appear in later sections.

4. The informal consultative panels, including specialists who are not members of the Committee, which were established during the year previous to that under review, have given valuable advice on several problems and research projects. The Committee record their great appreciation of the time and attention given to this work by those who served on these panels during the year. Members of these panels are:

> Mr. F. C. Bawden, Sir Daniel Cabot, Mr. T. Dalling, Professor F. G. Gregory, Mr. E. C. Lloyd, Professor W. C. Miller, Professor Macgregor Skene, Mr. J. Smith, Sir Harold Tempany, Professor D. Thoday, Professor T. Wallace and Dr. V. B. Wigglesworth.

5. An African Rinderpest Conference was held in Nairobi in October, 1948, to consider the control and eradication of rinderpest in Africa. This was immediately followed by an International Rinderpest Conference under the auspices of the Food and Agriculture Organisation of the United Nations to consider the international aspects of the African Conference and the financial implications of the extension of the policy laid down in Africa to Asia. The four representatives of the United Kingdom at the two Conferences included two members of the Committee, Mr. R. J. Simmons, the Adviser on Animal Health to the Secretary of State, and Dr. J. Carmichael. The question whether there is any danger of introducing rinderpest into the United Kingdom by the importation of immunised animals or the carcases of immunised animals has received much attention in view of the desirability of increasing the meat supply. It was considered by the African Rinderpest Conference and their resolutions were placed before the Committee. The Committee set up an *ad hoc* Veterinary Sub-Committee to consider whether anything could be done to enable meat to be imported into this country

from Africa. They recommended that efforts should be concentrated upon the eradication of the disease from wide areas of country containing large cattle populations.

6. Research into *Brucella melitensis* (Malta Fever) problems was first proposed in 1944, and in that year Dr. A. W. Taylor was engaged to carry out the investigation under a Colonial Development and Welfare scheme which included the building of a special laboratory unit at the Agricultural Research Council's Station at Compton, Berkshire. Since that date the scheme has suffered from an incessant series of delays and the building is still not begun. A recently-submitted report by Dr. Taylor on the work done explains that, while work with *Brucella melitensis* is impossible in the absence of the special laboratory facilities, he has conducted some preliminary work on vaccine strains of the closely-allied *Brucella abortus*. He outlines a future programme of work which must await the completion of the new laboratory.

7. Dr. Herklots, Secretary of the Committee, after attending the first meeting of the East African Advisory Council of Agriculture, Animal Industry and Forestry at Nairobi in January, paid short visits to Southern Rhodesia, Nyasaland, Northern Rhodesia, Kenya, Mauritius and Zanzibar. He met heads of technical departments and specialist officers and discussed research problems with them.

8. An International African Soils Conference was held from the 8th to the 15th November at Goma in the Belgian Congo. This was attended by representatives from all the British Colonial territories in Africa, as well as by the Secretary of State's Advisers on Agriculture and Forestry, Mr. G. F. Clay and Mr. W. A. Robertson. The Conference emphasised that further study of African soils is most important for the prevention of soil erosion, which as ever remains a menace in most parts of tropical Africa, and also for the development of systems of agriculture adapted to local conditions. The Conference undoubtedly served a most useful purpose. Among their many recommendations was one in favour of the setting up of a research organisation to be known as an "Inter-African Pedalogical Service" at Yangambi, in the Belgian Congo, under the auspices of the Institut National pour l'Etude Agronomique du Congo Belge (I.N.E.A.C.). The Conference also recommended the setting up of an International Information Bureau on questions of soil conservation and utilisation, with headquarters in Paris. Steps are being taken to follow up these and other recommendations.

II. PROGRESS IN THE ORGANISATON OF RESEARCH IN THE COLONIES

(a) *Regional Organisation of Research in East Africa*

9. The headquarters of the East Africa Agriculture and Forestry Research Organisation and the joint Animal Husbandry Section of this Organisation and of the East African Veterinary Research Organisation are to be established at Muguga. An area of a thousand acres, a part of the Muguga forest reserve, is being leased for a period of ninety-nine years. It is situated west north west of Nairobi at a distance of seventeen miles from the city and ten miles from Kabete. The new alignment of the Kenya and Uganda railway (with Muguga station convenient) and the main trunk road north from Nairobi pass just to the east of the reserve. East of the road is a large area of Kikuyu native land and immediately adjacent to the selected site, at the south east corner, is a small island of Kikuyu reserve. The headquarters will be built at an altitude of 6,815 feet; Nairobi is at 5,500 feet and Kabete at 6,210 feet. The lower part of the forest reserve lies within rainfall isobars

of 38 and 40 inches. A survey at five foot contours and a geo-physical survey have been completed and five hundred acres have been cleared of wattle in preparation for buildings and experimental plots. An artesian well has been sunk and extended trials have shown that there is ample water available for the needs of the two Organisations.

10. A Colonial Development and Welfare Research scheme has been made to provide funds amounting to £325,000 for the capital cost of the first phase of the development of the joint headquarters at Muguga and for the laboratories at Kabete for the East African Veterinary Research Organisation. It is estimated that a further sum of the order of £500,000 will be required for the second phase to enable the capital development of the joint headquarters at Muguga to be completed. Approval of the first phase does not imply any commitment in advance to endorse the second, but when the first phase has been completed, any application for funds made for the second phase will be carefully considered.

11. Of the moneys provided, road laying, the provision of power, light, telephones and water, the erection of offices, library and laboratories and the erection of European, Asian and African housing call for an expenditure of £214,000 and equipment is estimated to cost £61,000. At Kabete buildings are to cost £43,000 and equipment £7,000. This expenditure will enable the two regional organisations to develop over the next five years and works within the first phase of development to be completed.

12. The construction of the buildings at Muguga is to be carried out by the Kenya and Uganda Railway Engineering Department.

13. At Kabete it is planned to develop the Infectious Diseases Research Sections of the East African Veterinary Research Organisation, and the organisation will enjoy the benefits of close proximity with the staff of the Kenya Veterinary Department. At Muguga will be carried out researches on animal husbandry and other problems of animal health. Animal husbandry work will be carried out jointly with the East Africa Agriculture and Forestry Research Organisation.

14. Research into bovine tuberculosis is being carried out by a research officer equipped with a mobile laboratory which will enable him to pursue investigations of the disease in affected areas in Tanganyika. Other researches will be made at selected experimental stations in the territories, e.g., at Naivasha, Kenya. The object is to cater for any inter-territorial research problem that requires investigation.

15. The first meeting of the East African Advisory Council of Agriculture, Animal Industry and Forestry was held at Kabete, Kenya, from the 25th to the 27th January, 1949. The Council includes official and unofficial representatives from the East Africa High Commission, and from Kenya, Tanganyika, Uganda and Zanzibar, as well as the Directors of the East Africa Agriculture and Forestry Research Organization and the East African Veterinary Research Organization. At this meeting Messrs. C. G. Eastwood, G. F. Clay, R. J. Simmons and G. A. C. Herklots attended as observers from the Colonial Office. Observers from Northern and Southern Rhodesia also attended the meeting of the Council. The Council emphasized the need for establishing or improving facilities at stations in the main ecological zones of East Africa, where co-operation and co-ordination of research will be maintained between the regional organizations and the technical departments of the territorial Governments. At the request of the Directors of the two regional organizations specialist committees were appointed to deal with problems of grassland research, water utilization by vegetation and forestry research. It was agreed that other committees would be called into being

as and when required. The main function of the Council is to advise the East Africa High Commission on policy; it also will maintain liaison with the Central African Territories.

16. Dr. F. J. Nutman, as Director of Clove Research, started work with a small team of specialists in Zanzibar in November, 1947. The main object of this research is to investigate the disease of the clove trees known as "sudden death" and, if possible, to devise control measures. Mr. A. F. Posnette, an authority on virus diseases on the staff of the West African Cacao Research Institute at Tafo in the Gold Coast, visited the islands of Zanzibar and Pemba in July, 1948, and submitted a report to the Committee. A report on the situation in these islands was subsequently made by Dr. B. A. Keen and Dr. Nutman. As the result of a recommendation made by the Secretary of State's Agricultural Adviser, who had gone to Zanzibar, a mission was sent in March, 1949, to advise on methods which should be taken to check the spread of "sudden death" on Pemba Island. This mission, which consisted of Mr. F. C. Bawden, Dr. W. J. Hall, Dr. H. Martin and Dr. H. H. Storey, has now submitted a report which will be considered by the Committee.

(b) *Regional Organization of Research in West Africa*

17. Early in 1948 Dr. H. H. Storey paid a visit to the West African Colonies and discussed with the Governments and technical departments concerned the question of the organization there on regional lines of research in agriculture, animal health and forestry. He recommended that two regional organizations, parallel to those now set up in East Africa, should be established and he made detailed proposals for their inauguration. His report was studied carefully by the Committee and accepted as giving a general indication of the form which it was felt desirable that the proposed organizations should take. The Committee advised that the report should be sent to the West African Governments for their comments; and this was done by the Colonial Office.

18. In December the Colonial Office received information that the West African Council had generally endorsed the recommendations in the report and had asked that immediate steps should be taken to select and appoint two Directors, one for Agricultural and Forestry Research, and the other for Veterinary Research. It was proposed that the headquarters of the two organizations should be in Nigeria at Ibadan and Vom respectively. Research schemes have been made to provide for the appointment of the two Directors and the posts have been advertised.

(c) *Regional Organization of Research in the Malayan Region*

19. The Committee studied the report which Mr. G. F. Clay prepared following his visit to the Malayan region in April, 1948. In this he suggested, *inter alia,* that agricultural research should be developed on a regional basis for Malaya, North Borneo and Sarawak. The Committee agreed in principle to this recommendation and as a consequence the Secretary of State's Adviser on Animal Health, Mr. R. J. Simmons, and Dr. A. E. S. McIntosh, Deputy Director of Agriculture, Federation of Malaya, are visiting these territories and making a detailed study with this end in view.

(d) *Individual Colonial Development and Welfare Research Schemes*

20. A grant was made to the Government of Kenya to cover certain capital expenditure involved in the establishment of a coffee research station near Ruiru. The Kenya Government had purchased the site and the Coffee Board of Kenya had made a contribution towards the capital cost. The recurrent

costs of the station will be met from local sources. The main function of the station is to provide information on the various aspects of coffee cultivation and management in Kenya, many of which differ from those in other coffee producing areas in East Africa. This station will, in due course, be co-ordinated and linked with the East Africa Agriculture and Forestry Research Organization as a first order commodity research station.

21. Approval was recommended for a grant to provide for the salary for two years of an assistant to the Botanist at the Coryndon Memorial Museum, Nairobi. The large Amani herbarium will be combined with that of the Coryndon Museum for the benefit of the East Africa Agriculture and Forestry Research Organization and it is desirable that before this takes place the arrears of work at the Coryndon Museum herbarium should be overcome. With the aid of the assistant provided by this grant this can be done.

22. In relation to the accepted policy in Colonial agriculture that shifting cultivation be replaced by permanent farming where practicable, it is desirable that it should be possible to use meteorological data to permit of the delimitation of climatic zones for different agricultural usage. The part-time services of Mr. A. Walter (formerly Director of the British East African Meteorological Service) have been secured for a year to carry out researches into methods of correlating climate and agriculture. This work will fall under the general supervision of the Director of the East Africa Agriculture and Forestry Research Organization.

23. A grant has been made to the Government of Sierra Leone to meet the cost of a systematic botanist and ecologist to undertake, over a period of five years, a survey of the botany of the forests and other vegetation in Sierra Leone.

24. Research in the problem of rice cultivation in West Africa has received careful attention and the Committee has recommended that a first order rice experiment station be established at Rokupr in Sierra Leone which would become a centre for rice research in West Africa. Approval has been given for capital expenditure for laboratories and equipment and for housing, and for a proportion of the recurrent costs over the next five years.

25. A grant was recommended to allow Dr. George Salt of Cambridge University to work in East Africa under the aegis of the East Africa Agriculture and Forestry Research Organization for a period of one year. This was approved and Dr. Salt is now engaged in researches on the arthropod fauna of East African soils.

(e) *Studentships*

26. The problem of the recruitment of fully qualified personnel for specialist appointments has been discussed in relation to particular branches of investigation where the shortage has been felt most acutely. As a consequence schemes for studentships have been made. See paragraphs 36 and 44 below.

(f) *Termites*

27. A resolution of the Fifth Entomological Conference reads:

> "There is an urgent need for the expansion of research work on termites particularly in the Colonies. One or more entomologists should therefore be appointed to study termites in the field, with particular reference to their biology and their relationship to agriculture and forestry, and to study their taxonomy at an appropriate Museum."

Arising out of a consideration of this resolution, the Committee recommended that Mr. W. V. Harris, entomologist on the staff of the Agricultural Depart-

ment, Uganda, should if possible be placed whole-time and for an indefinite period on research on termites and that two men, in the first instance, should be trained by Mr. Harris to study termites in the field. The Government of Uganda has agreed to the secondment of Mr. Harris for five years to undertake this work, and a scheme for the training of entomologists will be made when Mr. Harris returns to this country in September, preparatory to commencing his new work.

III. REPORTS OF STANDING SUB-COMMITTEES

(a) *Cocoa Research Sub-Committee*

28. Two changes took place in the membership of the Sub-Committee during the year and the members are now: 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 held one meeting during the year, but have continued their practice of dealing with matters as far as possible by correspondence.

29. The problem which has been of chief concern to the Sub-Committee during this year has been that of the swollen shoot disease of cocoa in West Africa. The Secretary of State appointed a Commission of Enquiry from a panel of names supplied by the United Nations Food and Agriculture Organization. The members were Dr. G. H. Berkeley of the Dominion Laboratory of Plant Pathology, Ontario, Canada, Dr. W. Carter, Head of the Department of Entomology, Pineapple Research Institute, Hawaii, and Professor E. van Slogteren, Director of the Flower-bulb Research Laboratory, Lisse, Holland. The Commission visited the Gold Coast during November and December, 1948, and their report has been published as Colonial Number 236. In this they emphasized their complete agreement with the recommendation of the West African Cacao Research Institute that the cutting-out of diseased trees was the only method by which the spread of the disease might be checked. The report was examined by the Sub-Committee who put forward tentative suggestions for implementing the recommendations which it contained. Members of the Sub-Committee have also been actively concerned in the measures which have been taken to give effect to these suggestions.

30. The Sub-Committee have again given close attention to the work of the West African Cacao Research Institute, by a study of the quarterly reports of the Institute which have been circulated. Note has been taken of the many aspects of the research work which has been carried out at Tafo. These include the ecology and control of capsids, the biology of virus vectors, the introduction of parasites of the mealybug and the propagation and testing of clonal material. During the course of the year Dr. Campbell visited the Institute and the report which he prepared upon his return was circulated to the Sub-Committee.

31. Members of the Sub-Committee attended the Cocoa Conference in September, which was convened by the Cocoa, Chocolate and Confectionery Alliance Limited. Representatives of the industry and of the staffs of the West African Cacao Research Institute and the Imperial College of Tropical Agriculture were present. Matters which were considered by the Conference included the prospects for increased cocoa production in the New World and in the Far East, diseases and the work which is being done upon them and the marketing of West African cocoa. The proceedings of the Conference, which were published, have been circulated to those Colonial territories which are concerned in the production of cocoa.

32. The Sub-Committee have continued to keep under review the progress of the cocoa disease and rehabilitation campaign in the Gold Coast and the Nigerian cocoa survey. They have drawn attention to the severe losses which have been caused in recent years by black-pod and other pod diseases, particularly in Nigeria. It has been recommended that a plant pathologist should be attached to the staff of the West African Cacao Research Institute to work full-time on this problem.

33. Other matters which have been discussed include the progress of the West Indian cocoa research scheme which is being carried out under the aegis of the Imperial College of Tropical Agriculture, the problems involved in the transfer of planting material between Trinidad and West Africa and among the West Indian islands and the principles governing the proper fermentation of cocoa.

(b) *Soils Sub-Committee*

34. In the course of the year Dr. G. A. C. Herklots succeeded Dr. H. H. Storey as a member of the Sub-Committee and four additional members were appointed. They are Dr. W. Davies, Dr. F. Dixey, Professor H. G. Sanders and Dr. F. Yates. The other members are Sir William Ogg (Chairman), Mr. G. F. Clay, Dr. A. Muir, Mr. G. V. Jacks, Dr. E. M. Crowther, Mr. C. G. T. Morison, Professor G. W. Robinson, Dr. A. B. Stewart and Sir Harold Tempany. Two meetings of the Sub-Committee have been held during the year.

35. Members of the Sub-Committee attended the Commonwealth Agricultural Bureaux Specialist Conference on Tropical and Sub-Tropical Soils, which was held at Rothamsted in June 1948, and which originated in a suggestion put forward by the Sub-Committee. At a subsequent meeting the resolutions of the Conference were discussed and various methods were suggested by which these might be implemented subject to their acceptance and confirmation by the Committee of the Commonwealth Agricultural Bureaux.

36. Among other matters the Conference emphasised the urgent need of greatly increased staff for the purpose of carrying out further soil surveys in tropical and sub-tropical areas. In an attempt to remedy this situation the Sub-Committee recommended that funds should be made available for the training of young graduates to undertake soil research in Colonial territories. This recommendation was accepted by the Secretary of State; six studentships are to be offered in the first year and six in the second.

37. The Sub-Committee have drawn attention to the need for a thorough and comprehensive analysis of experimental data on the responses of tropical crops to fertilizers. The matter has been discussed and it has been recommended that a statistician should be appointed to carry out the analysis and that he should work at the Rothamsted Experimental Station under the direction of Dr. Yates. It has been decided that, in order not to place too great a burden on Colonial Departments of Agriculture, at the outset the analysis should in the first place be confined to sugar cane and Directors of Agriculture have been asked to supply the information which is required.

38. Among other matters, the Sub-Committee have examined proposals for a Gold Coast Soil Survey and have endorsed these subject to minor amendments; the placement of fertilizers under tropical conditions has been discussed; and, on the recommendation of the Sub-Committee, funds have been provided for the appointment to the staff of Rothamsted Experimental Station of an Adviser on Tropical Soils. It is hoped that this appointment will be filled in the near future.

(c) *Stored Products Research Sub-Committee.*

39. During the course of the year Dr. G. A. C. Herklots succeeded Dr. H. H. Storey as a member of the Sub-Committee. The other members are Sir John Simonsen (Chairman), Mr. G. F. Clay, Mr. W. McAuley Gracie, Mr. G. V. B. Herford, Mr. J. G. Hibbert, Mr. F. W. Irving, Professor J. W. Munro, Professor H. Raistrick and Mr. J. J. Scouler. The Sub-Committee has held six meetings during the year.

40. As in the previous year, the work of this Sub-Committee has been chiefly concerned with the activities of the West African Pest Infestation Survey and most particularly with the outbreak of *Trogoderma* infestation among stored groundnuts in the area of Kano in Northern Nigeria. The Sub-Committee have considered reports on this subject which were received from Mr. G. S. Cotterell, leader of the Survey Team, Mr. R. W. Howe, Senior Control Entomologist at Kano, and Dr. R. A. E. Galley of the Interdepartmental Standing Conference on Insecticides, who spent some time in the area in the course of a visit to West Africa. These reports have shown that the steps which have been taken to fumigate the infested nuts are likely to bring the outbreak under control, though not without considerable losses having been incurred. In order to achieve this result, however, it has been necessary for the Survey Team to devote the majority of their time during the past three or four months to work of routine control rather than of research. The Sub-Committee have therefore recommended that additional temporary staff should be recruited to take over the work of control and enable members of the Survey Team to continue their research into the sources of this infestation and other problems. From specimens which have been sent to this country it has been possible to make a positive identification of the beetle as *Trogoderma granarium.*

41. In August, 1948, Mr. Cotterell returned to this country for discussions and submitted to the Sub-Committee a progress report on the work of the survey up to that date. The technical aspects of the report were referred to a Working Party under the chairmanship of Professor Munro. The Working Party has made recommendations with regard to the preliminary implementation of the survey and these have been referred to the West African Governments concerned for their consideration.

42. The Working Party of the Sub-Committee set up to enquire into the most suitable conditions for the storage of food products in tropical and sub-tropical regions recommended that Mr. T. A. Oxley of the Department of Scientific and Industrial Research Pest Infestation Laboratory, Slough, should carry out a sample survey of storage conditions in tropical territories. Arrangements were made for a visit to the Colonial territories of East and Central Africa, funds being provided for this purpose from the Colonial Development and Welfare Research allocation. Mr. Oxley left this country in October, 1948, and submitted a full report upon his return in January, 1949. His report has been considered and endorsed by the Sub-Committee and will in due course be published. In the light of the views put forward by Mr. Oxley, the Sub-Committee has recommended that arrangements should be made for the attachment of a Colonial Liaison Officer to the Pest Infestation Laboratory, Slough. The Liaison Officer would be responsible for the exchange of information and would be available to offer advice to those in the Colonies who are responsible for questions of food storage.

43. On the recommendation of the Sub-Committee the code of practice governing the use of DDT and BHC with stored foodstuffs, which was prepared by Dr. R. A. E. Galley and Mr. R. P. Tew, has been circulated to Colonial Governments.

44. The Sub-Committee drew attention to the serious difficulties which have occurred in the past and are likely to be felt for some time in the recruitment of trained entomologists to undertake research in the Colonies in the field of stored products research. It was suggested that a number of studentships should be offered in order to train young scientists for this work and the Sub-Committee recommended that research funds should be made available for the purpose. The Secretary of State accepted this recommendation and a Colonial Development and Welfare Research scheme was made to cover the cost of the studentships, which have since been advertised. Three are being offered during the year 1949-50.

45. Other matters considered by the Sub-Committee included methods of handling and applying methyl bromide and other fumigants in tropical climates, the application to stored groundnuts of inert mineral dusts and the possibilities of thermal sterilisation of stored foodstuffs.

Colonial Insecticides Committee Second Annual Report (1948 -1949)

Imperial College of Science and Technology,
South Kensington,
London, S.W.7.
2nd June, 1949.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Insecticides Committee for the year 1948–49.

I am,
Sir,
Your obedient Servant,
IAN HEILBRON,
(Chairman)

The Right Honourable A. Creech Jones, M.P.,
Secretary of State for the Colonies.

COLONIAL INSECTICIDES COMMITTEE

Membership

PROFESSOR SIR IAN HEILBRON, D.S.O., D.Sc., LL.D., F.R.S., Professor of Organic Chemistry at the Imperial College of Science and Technology, *Chairman.*

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

DR. J. CARMICHAEL, late Colonial Veterinary Service.

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.

PROFESSOR G. MACDONALD, M.D., D.P.H., D.T.M., Director, Ross Institute of Tropical Hygiene.

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

PROFESSOR J. W. MUNRO, M.A., D.Sc., Professor of Zoology and applied Entomology, Imperial College of Science and Technology.

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

BRIGADIER A. E. RICHMOND, C.B.E., K.H.S., Director of Hygiene, War Office.

PROFESSOR SIR JOHN L. SIMONSEN, D.S.C., F.R.S., Director, Colonial Products Research Council.

Ex-Officio Members

The Secretary of State's Medical, Agricultural, Animal Health and Forestry Advisers.

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

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

The terms of reference of the Committee are :—

(i) to initiate Insecticide Research, including experimental field work;

(ii) to examine Insecticide Research and Experimental Schemes submitted to it by Colonial Governments or other appropriate bodies;

(iii) to advise on any problems concerning the use of insecticides which may be submitted to it;

(iv) to make available the latest scientific information to those concerned with the use of insecticides in the Colonies.

These terms of reference were further amplified at a meeting on the 21st March, 1947, when the Committee reached the following conclusions :—

(*a*) that it should concern itself primarily with the experimental application of the results of fundamental insecticide research ;

(*b*) that in the final stages of the development of insect control it would almost certainly be necessary for the Committee to sponsor field experiments on a large scale ;

(*c*) that it should be its task to encourage and reinforce when required research projects undertaken by Colonial Government Departments ;

(*d*) that it should co-ordinate agricultural, medical and veterinary interests in the use of insecticides. In this connection the need for full consideration being given to the effects of insecticides on beneficial insects was emphasised, and also the need for experiments to ascertain the ecological problems involved in the use of insecticides.

COLONIAL INSECTICIDES COMMITTEE

SECOND ANNUAL REPORT

CONTENTS

CONTENTS—continued

COLONIAL INSECTICIDES COMMITTEE
SECOND ANNUAL REPORT

PART I. WORK OF THE COMMITTEE

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

2. *Meetings.* The Committee held three meetings and the Sub-Committees on Malaria and Aircraft Trials each held six meetings during the period under review.

3. *Colonial Insecticides Research Team, Porton.* After delays in the completion of accommodation and the supply of equipment, research work by the Colonial Insecticides Research Team at Porton, near Salisbury, is now under way. Interesting results have been obtained on the influence of crystal size on toxicity to mosquitoes and tsetse flies, and the application of this factor to the composition of wettable powders. Effect of particle size and particle distribution on toxicity is also being studied. Further details of these investigations and others are given in paragraphs 33-44.

4. *Colonial Insecticides Research Unit, Uganda.* A great deal of the time of the staff during the latter half of the year has been devoted to aircraft experiments against tsetse flies, which are referred to later in this Report. Experiments with impregnated screens have been continued and it now seems clear that although this method will not provide a means of eradication of the fly it may be useful as a subsidiary measure of control (paragraph 45). Further trials with ground insecticidal smoke generators have confirmed that both DDT and BHC smokes are lethal to tsetse flies, but application still presents difficulties (paragraph 46). Two field experiments at Kasanji and Jinja on the control of malaria by the treatment of native huts with DDT and BHC sprays have been continued and a new one started at Mbale. These are discussed in paragraphs 58-60. Further details of the Unit's work have been reported to the Colonial Insecticides Committee in Reports Nos. 5 and 6 of the Unit.

The Committee record with deep regret the tragic death by drowning of Mr. D. J. H. Haxell, a member of the Unit, while on holiday in Jersey.

5. *Change of Location of the Colonial Insecticides Research Unit.* Owing to the extension of the activities of the Uganda Veterinary Department, the Unit have been asked to vacate its present accommodation in Entebbe. The new headquarters of the Unit will be in Tanganyika, probably at or near Arusha. The majority of the members of the Unit have already moved to temporary accommodation near Arusha in order to carry out the next series of the aircraft trials which are being conducted in that area. The Unit will, however, continue to maintain for the time being a small section in Kampala, Uganda.

6. *Need for Fundamental Research.* The growing extensive use of insecticides in the public health, agricultural and veterinary fields is emphasising the grave lack of fundamental data essential for their proper use. More knowledge is needed by the field entomologist on which he can base his experiments, and it was for this reason that the Committee established a Research Unit at Porton. The Unit can, however, make only a comparatively small contribution to the total needs in this direction. As the result of a decision of the Committee, an " ad hoc " Sub-Committee meeting was called to consider the more important problems and suggest how Government Research Institutions, University Departments and Industrial Laboratories might be encouraged to increase their research efforts along these

lines. A general shortage of research staff will undoubtedly prevent rapid progress, but the Officer-in-Charge of Research to the Committee is endeavouring to interest research bodies in the insecticide problems which are of particular importance to the Committee's activities.

7. *Mosquito Eradication, Cyprus.* The Committee has kept in close touch with the development of the mosquito eradication campaign being conducted in Cyprus. On its recommendation arrangements were made for Dr. J. R. Busvine, a member of Professor Buxton's staff, to visit Cyprus during July, 1948, in order that he might gain first hand knowledge of the methods used. Dr. Busvine spent three weeks in the island. In each week, five or six days were spent travelling about to observe the terrain and the difficulties it presents to the Anopheline Eradication Service, and to search for mosquitoes. In all, Dr. Busvine travelled approximately 750 miles. This fairly extensive itinerary was only possible through the help of the Cyprus Government and its officers, particularly Mr. Aziz and Dr. Shelley of the Medical Department. The Committee wish to record their appreciation of the great assistance and hospitality which was afforded to Dr. Busvine.

On his return Dr. Busvine submitted to the Committee an account of his visit. Recent information indicates that the *Anopheles* mosquito has been eradicated from Cyprus, and that it should now only be necessary to maintain a thorough inspection service to prevent introduction from outside sources.

8. *Malaria Control in Malaya.* Experiments to determine the effect on the incidence of malaria of a number of different treatments have been designed by Dr. Field and Mr. Reid of the Institute of Medical Research, Kuala Lumpur, Malaya. Four similar isolated areas in South Negri Sembilan have been chosen, each with a Malay population of 1,000 to 1,500, and typical of the areas where malaria due to *Anopheles maculatus* is an important problem. Following a preliminary survey, the houses in one valley will be sprayed with DDT, those in the second valley with BHC, in the third paludrine will be administered to the population, and the fourth valley will remain untreated and serve as a control.

An outline of this scheme was submitted in December, 1948, to the Secretary of State by the High Commissioner of the Federation of Malaya, with a request that it should be financed by a grant from Colonial Welfare and Development Research funds. Approval was asked for a small provisional grant prior to submission of the detailed scheme, so as to enable preliminary data to be collected before the onset of the main malaria period in March, 1949. This matter was referred to the Malaria Sub-Committee of the Colonial Insecticides Committee, and on its recommendation the Secretary of State approved a provisional grant.

The detailed scheme has subsequently been received and considered by a meeting of the Malaria Sub-Committee, at which members of the Colonial Medical Research Committee were present. The Colonial Medical Research Committee is particularly interested in these experiments, as they are, in a sense, an extension of the earlier paludrine experiments carried out on its recommendation. It has now been recommended to the Secretary of State that a grant should be made from Colonial Welfare and Development funds to enable the experiments to be undertaken.

9. *Malaria Eradication Experiment, Mauritius.* In the last Report (paragraph 13) an account was given of the malaria problem in Mauritius and of the eradication experiment planned by the Committee. The research and directive team under Dr. M. A. C. Dowling arrived in the island in November, 1948, and the campaign has now entered its first phase. Details

of the work carried out to date are given in paragraphs 76-79. A very gratifying feature of the campaign is the wholehearted co-operation of the population and the very considerable assistance which the local authorities are giving to the team. Extensive publicity by the island radio and the local press is keeping the population up to date with the latest developments in the campaign. Mr. C. B. Symes, O.B.E., the Officer-in-Charge of Research to the Committee, visited the island in February, 1949, to discuss with Dr. Dowling the early stages of the work.

10. *Malaria Experiments in Swaziland.* During his visit early in 1948, Mr. Symes advised the authorities in Swaziland to undertake an experiment on the residual spraying of houses with DDT and BHC, to control malaria. The spraying of three areas with different formulations was started in December, 1948. Mr. Symes visited Swaziland again in February, 1949, and his observations on the work are given in para. 83.

11. *Insecticide Research in West Africa.* The Committee continues to explore the possibility of establishing a Colonial Insecticides Research Unit in West Africa. During a visit which the Secretary paid to the Gold Coast and Nigeria in March, 1949 (see para. 22) he obtained the views of many of the local departments interested. There seems no doubt that the establishment of a Unit in West Africa would serve a useful purpose and would be welcomed. The Secretary also visited the University College of Nigeria at Ibadan, where the Committee has been offered accommodation should a Unit be formed. The difficulty of obtaining the scientific staff prevents the immediate formation of a Unit, but it is hoped that this may soon be overcome.

12. *Behaviour of Mosquitoes in Huts treated with DDT and BHC.* Dr. Muirhead Thomson, who has been working under the aegis of the Colonial Medical Research Committee, has concluded from his experiments in West and East Africa that DDT is ineffective against *Anopheles gambiae* mosquitoes entering huts, the walls of which have been treated with it, owing to the irritant action of DDT, which causes the mosquitoes to leave the hut before they have received a lethal dose. On the other hand, Dr. Muirhead Thomson found BHC to be very effective. Although these findings are not supported by results in other parts of the world with other species or by the Colonial Insecticides Research Unit's own experience with *Anopheles gambiae,* the Committee realise that the implications are so far reaching that the work should be repeated as soon as possible. The Committee has an entomologist in view for this research and hopes to obtain his services later in the year. In the meantime the Colonial Insecticides Research Unit in Uganda are resuming their own studies on the behaviour of *Anopheles gambiae* and *Anopheles funestus* in treated huts (para. 61).

13. *Disinfestation of Aircraft.* Reference was made in the last Report (para. 20) to an experiment started to determine the effects on insects entering aircraft of applications to internal surfaces of various formulations of DDT and BHC. Some interesting results have already been obtained (see para. 62). It was found that three months after treatment all surfaces were lethal to *Aedes aegypti* mosquitoes exposed to one hour contact. In February the first of a series of monthly observational flights was made between Nairobi and Entebbe. Mosquitoes were released in the treated cabins of the aircraft, and neither on the outward nor the return journey were any live insects found. The observational flights are continuing.

14. *Aircraft Experiments against Tsetse in East Africa.* By contract with Messrs. Airwork Limited two Anson aircraft were made available to the Committee in June, 1948. These were fitted with specially designed tanks and emission pipes for liquid insecticide formulations and with apparatus for the production of exhaust insecticidal smoke. After preliminary tests

and assessment trials in the United Kingdom, experiments were begun in East Africa in November, 1948. A summary of the results of the first series of experiments with both spray and smoke is given in paras. 50-57. It is hoped to produce a detailed report in the near future. The experiments involve a very laborious assessment technique, and it is too early to indicate results, but the trials so far conducted emphasise how much there is to learn of this method of insecticide application. The aim of the experiments is to devise a technique which will make it possible to disseminate insecticides on to the area to be treated in an optimum spray pattern and droplet size without using excessive material. At the same time the droplet size must be such as will penetrate the vegetation canopy and leave a residual deposit where required. Not until these problems are solved will it be possible to assess the economic possibilities of disseminating insecticides against tsetse from the air.

15. *Helicopter Experiments.* Arrangements have been made through the Ministry of Supply for the purchase of a twin engined three-rotor Cierva Air Horse Helicopter, which is at present in the course of design. The single-engined protoype of this helicopter, which is the largest in the world, has now flown and is undergoing reliability trials. The Ministry of Supply have agreed, when these are successfully completed, to make the aircraft available to the Committee for experiments on spraying insecticides. This is expected to be towards the end of the year. In the meantime the Committee is 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. The programme of the trials has been drawn up in discussion with the Officer-in-Charge of Research to the Colonial Insecticides Committee, and it is being carried out at the Chemical Defence Experimental Establishment at Porton. The trials to date have been financed by a grant from the Agricultural Research Council. A small team has been recruited, and the experiments are under the immediate direction of the Head of the Engineering Section of the Chemical Defence Experimental Establishment of the Ministry of Supply at Porton, who has supplied the summary of results given in para. 84.

16. *Experiments Against Tsetse in Swaziland.* Reference was made in the last Report (para. 18) to the application by the South African Air Force of insecticidal smoke to tsetse (*Glossina pallidipes*) infested areas in Swaziland. Eighteen DDT smoke applications were made and flies have been reduced to very small numbers. The Officer-in-Charge of Research, on behalf of the Swaziland Government, discussed with firms in the United Kingdom the supply of ground smoke generators for the treatment of ravine thickets and evergreen bush, where it is thought the smoke from aircraft may not have penetrated. As a result, the Swaziland Government have purchased from Imperial Chemical Industries Limited 12,000 generators, and the firm has supplied a further 12,000 free of charge. These have already been sent to Swaziland.

17. *Disinfestation of Trains Against Tsetse.* A Todd Insecticidal Fog Applicator has been loaned to the East African Tsetse Reclamation Department for trials in removing tsetse flies from the outside of trains. In preliminary experiments a cold, finely divided pyrethrum solution, delivered on to slow moving trains through wide mouthed hoses placed one on each side and one in the middle of the railway track has given very promising results.

18. *Simulium Fly and Onchocerciasis.* A brief description of Onchocerciasis and the very successful experiments carried out in Kenya to eliminate the vector fly, *Simulium neavei,* was given in last year's Report (para. 30). The

proposed large hydro-electric scheme on the Nile near Jinja has necessitated a study of the problem in that area. Preliminary observations by Mr. P. R. Wilkinson, an entomologist of the Colonial Insecticides Research Unit, are recorded in para. 75.

19. *Ecological Experiments.* The urgent need for data on the effect of the new synthetic insecticides on the general insect population, and particularly on beneficial species, has been kept constantly in mind. As mentioned in the last Report, a research scheme has been drawn up and the one factor in preventing its implementation is the difficulty in obtaining an officer with the necessary qualifications to direct the work. An official approach has been made by the Secretary of State to two Colonial Governments for the secondment of entomologists, but unfortunately these officers cannot be spared from their present duties. Efforts to find a suitable officer are, however, being actively pursued.

20. *Herbicide and Defoliant Experiments, Kongwa.* During the first three months of 1949 a member of the staff of Pest Control Limited was attached to the scientific section of the Overseas Food Corporation at Kongwa, Tanganyika, to carry out a series of preliminary trials with herbicides against weeds of groundnuts. It was also proposed that a number of experiments should be conducted with defoliants on bush vegetation. Professor G. E. Blackman, of the Department of Agriculture, University of Oxford, advised on the layout and conduct of the experiments and visited Tanganyika towards the end of the trials. The Committee was invited to collaborate in this research. The report of the herbicide experiments cannot be completed until the field experiments have been harvested, and this data, together with the weed count, analysed. Only a limited number of experiments were carried out on bush defoliation. The preliminary report has shown, however, that relatively small quantities of growth regulating substances applied as oil emulsions are capable of defoliating some of the main species in the bush at Kongwa. It is equally clear, however, that different botanical species may vary widely in their reactions to the defoliants used. The Committee hopes to increase its effort in this field of research.

21. *Control of Froghoppers on Sugarcane in Trinidad.* Reference was made in the last Report (para. 27) to experiments on the control of froghopper (*Tomaspis saccharina*) on sugarcane in Trinidad. This problem has engaged the attention of investigators of the Department of Agriculture and of the Sugar Industry of Trinidad for the past forty years, without a successful method of control being found. Recent developments of the new synthetic insecticides, DDT and BHC, had, however, increased the hope that it might be possible to ensure complete control of the pest. The most recent method of control by high-powered tractor-operated dusting machines has been subject to some criticism and Messrs. Caroni Ltd., who operate large estates in some of the more heavily infested areas, have been considering for some time the use of a helicopter to distribute insecticide dusts and sprays. The firm, who are to be congratulated on their enterprise, decided to carry out a series of experiments with this method during the froghopper infestation season beginning in mid-June, 1948. As there was no British-made helicopter adapted for agricultural purposes available at the time, Messrs. Caroni hired a Bell helicopter from the United States. The experiments were carried out by the research staff of Messrs. Caroni Ltd., under the direction of Mr. W. H. Gilbert and Mr. F. B. Blackburn. Close collaboration was maintained with the staff of the Department of Agriculture. At the request of Messrs. Caroni Ltd., the Colonial Office made available Lieut.-Colonel H. J. Holman, the Secretary of the Colonial Insecticides Committee, who visited Trinidad from 17th June until the 10th July, to observe the early

stages of the experiments. Trials were carried out with both DDT and BHC dusts and with oil sprays. The dusts were shown to give excellent kills of adult froghoppers when applied in the early evening, but there was no residual effect, with the result that the insect population built up again within a few days. It was hoped that oil sprays might prove more weather resistant and give some residual effect, but unfortunately shortly after oil experiments were started the helicopter met with an accident and the investigation had to be abandoned. While it is disappointing that a method of control of the froghopper has not been developed as a result of this work, the experiments have disclosed some very interesting aspects of the problem. These are discussed more fully in para. 85.

22. *The Chemical Destruction of Trees and the Development of Prophylactic Methods for the Protection of Cacao in Swollen Shoot Areas.* The Report of the Commission of Enquiry into the Swollen Shoot Disease of Cacao in the Gold Coast (Colonial No. 236, 1948) drew attention to the need for immediate investigation on the chemical destruction of trees and the development of prophylactic methods for the protection of cacao. Dr. W. Carter, one of the Commissioners, subsequently elaborated his views at a meeting held at the Colonial Office on the 17th December, 1948, and urged that the assistance of firms of chemical manufacturers should be enlisted without delay in order that an early solution might be found to the problems. Joint meetings of the Cocoa Research Sub-Committee of the Committee for Colonial Agricultural, Animal Health and Forestry Research and a number of members of the Colonial Insecticides Committee were held to discuss the question, and as a result the Association of British Chemical Manufacturers was invited to nominate four of its members to form the nucleus of a Mission to visit the Gold Coast under the aegis of the Colonial Office, in order to investigate the possible use of chemical arboricides for the destruction of cacao and forest trees, and of insecticides as a means of facilitating the rehabilitation of devastated areas and of protecting established cacao.

A Mission of seven scientists, including four representatives of British Chemical Industry, was appointed and arrived at Accra on the 27th February, 1949. The Mission immediately proceeded to Tafo, where the members remained as guests of the Director of the West Africa Cacao Research Institute and his staff until the end of their visit on the 9th March. The Mission comprised the following:—

Dr. C. T. F. Hunter (Pal Chemicals Ltd.).
Mr. L. R. Reed (Plant Protection Ltd.).
Dr. W. E. Ripper (Pest Control Ltd.).
Dr. T. Swarbrick (Shell Petroleum Ltd.).
Dr. E. M. Woodford (University of Oxford).
Dr. R. A. E. Galley (Agricultural Research Council and member of the Colonial Insecticides Committee).
Lieut.-Colonel H. J. Holman (Secretary of the Colonial Insecticides Committee).

At the request of the Director of the West Africa Cacao Research Institute, the original terms of reference were extended to cover the question of the control of capsids on cacao in so far as this involved the use of chemicals. The Mission has now submitted its Report to the Secretary of State for the Colonies. The Committee would like to record its appreciation, particularly to the Director of the West Africa Cacao Research Institute and his staff, for the hospitality and the very great help afforded to the Mission during its visit.

23. *Protection of Timber against Termites.* In the last Report (para. 55) it was recorded that small slabs of timber, treated by dipping for very short periods in various emulsions and oil solutions of DDT and BHC, proved resistant to termite attack for 17 months. These experiments have been continued and the treated wood has now remained resistant to termite attack for 27 months.

24. *Spraying Equipment.* The following sprayers for the application of insecticide residues to houses are being thoroughly tested under field conditions by the Committee's teams in East Africa and Mauritius:—

(i) Aerostyle light motor-driven sprayers with both fixed and detachable chassis and both conical and flat spray nozzles.

(ii) Lister engines fitted with spray equipment to the specifications of the Ministry of Agriculture with slight modifications by Dr. H. G. H. Kearns of the Horticultural Research Station, Long Ashton.

(iii) Four-Oaks " Kent " pattern knapsack sprayers.

(iv) Gardiner Fortemist (Acid) sprayer.

Some progress has been made in the design and production of improved sprayers also for residual spraying in houses. At the request of the Committee, Dr. Kearns has kindly redesigned the Gardiner Fortemist (Acid) Sprayer to meet the need for a light but robust manually operated power sprayer for use in towns and on estates where houses are close together. Ten of these are now in production and will be available shortly. In 1945, following a request by Mr. Symes for research work on sprayers, a grant was made from Colonial Development and Welfare Research Funds for the development of a knapsack sprayer to meet the special requirements of the Colonial Insecticides Research Unit in East Africa. The design and production of the sprayer has been carried out by Amalgamated Engineering and Development Ltd., under the guidance of the Sprayers Sub-Committee of the Inter-Departmental Research and Development Co-ordinating Committee. Four prototypes incorporating novel features of design have now been produced and will be tested by the Committee's teams both in this country and overseas. Five specimens of another knapsack sprayer designed by the Chief of the Engineering Section at Porton and produced under the aegis of the Sprayers Sub-Committee are also to be tried overseas. In future it is proposed to test out all new spraying equipment in Africa, Mauritius and British Guiana.

25. *Training of Young Graduates in Insecticides Research.* There is a grave shortage of trained scientific personnel for employment in insecticide research in the Colonies. The Committee has recommended that to meet the situation the award should be made of six studentships to young graduates, for training in insecticides research in the United Kingdom, preparatory to taking up employment with insecticide teams in the Colonies.

26. *Beit Scholars.* Two Beit Scholarships are being offered to Southern Rhodesians in the near future. The Committee has agreed to a request that the selected men should receive part of their training by attachment to the Colonial Insecticides Research Unit in East Africa.

27. *American Research Workers.* Approval has been given by the Economic Co-operation Administration to a project inviting American scientists partly paid for from E.R.P. funds, to work with British research workers in Africa on schemes designed to increase the knowledge of, and to assist in the struggle against trypanosomiasis, malaria and the insect-borne diseases of men, cattle and crops. An official request has been made for the assistance

of American scientists to work on insecticide problems. In this connection the work of the Committee and the type of officer required was explained to the American liaison officer during his recent visit to this country. It it felt that American scientists could best be used by incorporating them into mixed teams with British workers having a knowledge of local conditions.

28. *Liaison with Scientists Overseas.* An appreciable correspondence continues to be received by the Officer-in-Charge of Research and the Secretary from scientific workers in the Colonies. It has been possible to give assistance in those cases where advice has been sought. A number of workers overseas keep the officers of the Committee informed of the progress of their research, and it would be of great help if this practice were extended.

29. *Overseas Visits by Officers of the Committee.* From January to March, 1949, the Officer-in-Charge of Research visited Mauritius, Uganda, Tanganyika and Swaziland. At the suggestion of the Scientific Secretary, Central African Council, he also spent a few days in Southern Rhodesia, where he discussed with those engaged in insecticide applications in Central Africa some of their major problems. The Secretary visited Trinidad for three weeks in June and July, 1948, breaking his outward journey for a few days in Jamaica. He also visited the Gold Coast and Nigeria in March, 1949.

30. *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. An interesting outcome of discusssions held over a year ago with members of the scientific staff of the Shell Petroleum Company is the development of a new DDT suspension which, from preliminary investigation, appears to have qualities in certain directions appreciably in advance of other similar formulations which have come to the notice of the Committee. At the firm's request arrangements have been made for a member of its scientific staff to be attached to the Colonial Insecticides Research Unit in East Africa to study the application of this new product in the field. The total cost of the attachment will be borne by the firm itself, but the scientist will work as a member of the Colonial Insecticides Research Unit and the results of the research will be freely available to the Committee.

There is no doubt that industry has a very real contribution to make towards solving many of the problems of insect control, and the Committee recommended at its meeting in November, 1948, that, subject to the proper safeguards, the assistance of industrial organisations might be enlisted on appropriate problems. The Officer-in-Charge of Research gave a lecture entitled "Insecticides for the Solution of some Major Problems in the Colonies," to members of the Industrial Pest Control Association. The Committee wishes to record its thanks to those firms who on many occasions have readily given their assistance and co-operation.

31. *Conferences.* The Officer-in-Charge of Research served as a delegate at the Commonwealth Entomological Conference held in London in July, 1948, and was Chairman of the section on tsetse control. He also read a paper on "Commonwealth Air-Route Sanitation" at the Congress of the Royal Sanitary Institute held at Harrogate in May, 1948.

32. *Publications.* A list of papers published during the year is given as an appendix to this report.

PART II. REVIEW OF RESEARCH WORK

Colonial Insecticides Research Team, Porton

33. (12.)* The staff at present consists of two entomologists and one chemist, with one junior assistant; there is a vacancy for another assistant. This team will work on some of the more fundamental problems of insecticides and their application that cannot be dealt with adequately in the field laboratories. Full scale work was seriously held up through delays in the arrival of equipment, and much time has been spent in the setting up and calibration of laboratory equipment, establishment of insect colonies and standardization of techniques inherent in the start of a new laboratory. Test insects in use are *Aedes aegypti, Anopheles maculipennis, Glossina palpalis* and *Calandra granaria.* Others will be added when possible. Special apparatus includes a spraying tower as described by Webb (*Bull. Entom. Research, 38,* 209, 1947) and a spinning disc sprayer, as designed by Walton of the Chemical Defence Experimental Establishment, Porton.

Aircraft Trials

34. A considerable amount of time was devoted during September to the preliminary trials with the Anson aircraft before their departure for Africa.

Todd Insecticidal Applicator

35. In two tests with the use of Waxoline Red dye incorporated in the solutions used, it was shown that deposits on vertical surfaces were very small unless they were very near to and in the line of the jet of aerosol.

Crystallization Procedure for the Estimation of pp' DDT

36. (i) The method of Cristol *et al* was found to be more convenient than that of the Ministry of Supply (Inter-Departmental Insecticide Committee's Abstracts and News Summary No. 5).

(ii) A modified form of the Schecter Haller determination of DDT is being used for the assessment of decomposition under varying conditions.

Gamma Isomer of BHC

37. It has been confirmed that the isomer of BHC can be separated qualitatively by partition chromatography, but it has not been possible, yet, to use this method for estimation of gamma isomer in very small quantities of the crude insecticide.

Effect of "Space" and Temperature on Recoveries of Tsetse Flies exposed to Treated Surfaces

38. In the development of laboratory techniques for exposing flies to treated surfaces it was found, in a number of tests, that tsetse flies exposed for 15 seconds to 100 mgms/sq. ft. of DDT and then kept individually in 2″ × 1″ tubes suffered a 70-77 per cent. mortality, whilst other tsetses similarly exposed but kept in 4″ × 3″ small gauze cages suffered only 20-25 per cent. mortality. There were no deaths in controls kept in both tubes and cages. Two series of tests indicated that tsetses which were exposed to a surface treated with DDT in Kerosene at 100 mgms/sq. ft. and then stored at 25°C. and 20°C., showed much greater mortality in the batches kept at 20°C. This confirms, for tsetses, the observations of Potter and Gillham (*Ann. Appl. Biol., 33,* 142 (1946) on *Tribolium castaneum*).

Effect of Physical State of Insecticide Deposits on Toxicity to Tsetses

39. Wet oily non-crystalline deposits from pure DDT in kerosene are highly toxic, but lose toxicity when, after about 24 hours or so, the solvent

* Figures in parentheses refer to the corresponding paragraphs in the 1947-48 Report.

has evaporated and the insecticide has crystallized. When commercial DDT is used the oily deposit remains much longer, with a correspondingly longer period of high toxicity. But this, too, loses toxicity when dry and crystallized. If 10 per cent. of a relatively non-volatile oil, such as cotton seed oil, is added to the pure DDT-kerosene solution, the period of high toxicity is prolonged, because, though crystallization takes place after about 24 hours, the crystals are covered with a thin film of the oil. If dry non-toxic crystals from pure DDT-kerosene solution are sprayed with a mixture of kerosene and cotton-seed oil, they recover toxicity.

Wettable Powders

40. An examination of certain wettable powders now available has been started. Particle sizes of 50 per cent. of the mass of four powders were as follows:—

Trinidad JP 50W, 50 per cent. DDT American ...	6.6 μ
Murphy Chemical Co. 50 per cent. DDT	9.0 μ
Geigy Co. 50 per cent. DDT	12.0 μ
Shell "Ditrene"	37.0 μ

The toxicity to *Aedes aegypti* of suspensions of these applied to glass plates and plaster blocks of 35 porosity, at. 100 mgms/sq. ft., was inversely proportional to their particle sizes.

Crystal Size and Toxicity

41. The conclusion reached in the preliminary work on wettable powders (above) was confirmed for pure DDT crystals. In tests for toxicity of crystals of 0-60 μ, 60-100 μ, 100-130 μ and 130—à, the 0-60 μ fraction was by far the most toxic to *A. aegypti* and *G. palpalis*. In further tests of crystals of 0-5 μ, 5-10 μ, 10-20 μ, 20-40 μ and 40-60 μ, separated by sedimentation, those of 20 μ and under were most toxic to both test insects.

Diluents of Wettable Powders

42. There is evidence that some diluents interfere with toxicity by masking the particles of insecticides, and that the degrees of masking are influenced by types of surface and perhaps porosity. This question is being studied; suspensibility and wettability will also be considered.

Incorporation of Insecticides in Plastic Films

43. Preliminary attempts to incorporate DDT in chlorinated rubbers, paraffin waxes, lacquers and varnishes, with a view to the production of a lasting insecticidal treatment for the better types of surfaces in houses, have not yet met with success. Amounts as low as 1 per cent. of the materials used appear to mask concentrations of up to 20 per cent. of insecticide incorporated with them.

Effects of Drop Size and Drop Distribution on Toxicity to G. palpalis

44. In this study the spinning disc is being used to obtain deposits of 40 per cent., 20 per cent., 10 per cent. and 5 per cent. (pure) DDT in power kerosene and cyclohexanone in the form of drops ranging from 100 μ to 600 μ, at distributions, or densities, of 5.5 to 4,000 per square inch. This work so far indicates that drops of 100 μ to 200 μ at a density of 1,000-2,000 per square inch, and containing 20 per cent. or more of DDT may be the most toxic. It confirms, too, the observation recorded in para. 39, that wet drops are much more toxic than dry crystalline ones, and that crystallization of the solution used takes place in 24 to 48 hours under ordinary laboratory room conditions.

Colonial Insecticide Research Unit, Uganda

Tsetse

Field Experiments with Impregnated Screens

45. (41) *Experiment No.* 14: Observations were continued for another 7 months (10 months in all) when fly density was approximately 35 per cent. of its pre-treatment state. It would seem, therefore, from these results and those of previous experiments with this method, that treated screens may be useful for protection at river crossings and watering places, in corridors through infested bush, and as a subsidiary measure of control, but it is unlikely that alone they could be expected to eradicate fly.

Field Experiments with Insecticidal Smoke from Generators

46. (42) *Experiment No.* 19: As previously reported, Mukusa Island was smoked four times at 14-day intervals with 180 one pound BHC generators. Density was 10 males per boy hour before treatment and 4 per boy hour one month after the last treatment. It was observed that after each treatment, which appeared to reduce fly by 80-90 per cent., there was a rapid increase of flies. These increases were obviously due to emergencies of adults from pupae underground, and it was thought that if treatments could be continued over a longer period until all pupae had emerged, the final increase could be prevented. In August to November, therefore, the same island was smoked 8 times at fortnightly intervals, but with five large 20 lb. generators in place of the 180 small ones. Distribution of smoke was not easy with these large generators. One of them was carried in a canoe along the windward side of the island, and the others dragged along paths cut at about 100 yard intervals across the island. Immediate reductions of fly were not so striking as with the small generators, partly because fly densities were already low, but the final reduction was of the same order as in the previous trial. There is no doubt that both DDT and BHC smokes are lethal to tsetses, but application presents difficulties.

Experiments with Insecticidal Fog generated by the Todd Insecticidal Fog Applicator (T.I.F.A.)

47. (43) *In Thornbush (Experiment No. 16a).* Two previous experiments against *G. palpalis* and *G. morsitans* were recorded in the last Report. Further trials were conducted with this machine in co-operation with the Tsetse Research Department, Shinyanga, against caged *G. swynnertoni* in the thornbush of Block 9 at Shinyanga. Fogs of both BHC and DDT, and of the following approximate ranges of particle sizes were used: ½ to 1 micron, 15 to 25 microns and 30 to 60 microns. The caged flies were placed at 100 yard intervals for a ½ mile depth in the bush and 8-10 lb. of insecticide in 5 per cent. solution was then released in fog over a ¼ mile front roughly at right angles to the lines of cages. Changes in wind direction during application and afterwards made strict comparison of the two insecticides impossible, but BHC seemed to be more effective than DDT in the medium and large particle sizes, with practically 100 per cent. kill of flies up to 600 yards in the bush. The dosage was equivalent to 3 ounces of BHC (.02 lb. of gamma) per acre.

Effects on Fly Population of treating Breeding Grounds of G. palpalis.

48. *Experiment* 18: If overall spraying of infested bush could be done thoroughly, it is possible that adult flies emerging from pupae might be affected by spray deposited on breeding grounds. It is unlikely to have any very appreciable effect on fly populations, except on *palpalis* in high concentrations. In order to test this, after preliminary observations in the

laboratory, the main breeding places on the small island of Sanga were sprayed once with a solution of BHC in power kerosene. Percentage of young males which had varied between 14 and 20 over four months before the treatment, dropped to 5 per cent. afterwards, and remained at that figure for some weeks.

Effect on Population of G. palpalis *of an Insecticidal Treatment of Peripheral Vegetation only.*

49. *Experiment* 17: On islands and the lake shore, tsetses spend much of their time patrolling the bush along the shores in search of food. It was thought useful to discover what effect a treatment of shore bush only might have on fly density. In earlier experiments of this kind, bush on the shores and at many selected places inland has been treated. Bush around the 20 acre island of Ziribange was therefore sprayed from a boat four times at about three-weekly intervals with a Shell DDT emulsion (TP 691) at a strength of 2½ per cent. DDT and a dosage equivalent to ¾ lb. of DDT per acre at each application. Chemical estimations of deposits on shiny *Alchornea* leaves gave mean dosages of 100 mgms/sq. ft., and on hairy *Triumfetta* leaves 300 mgms/sq. ft. Mean fly catches fell rapidly from 5 males to 2 males per standard catch, and then slowly, the mean catch during the month after treatment remaining at 1.5.

Insecticide Applications from Fixed Wing Aircraft.

50. Two Anson aircraft became available in June, 1948. They were fitted with the Porton design tanks and emission pipes for liquid formulations, as well as the apparatus as used in South Africa for exhaust insecticidal smoke. Preliminary studies were conducted at Porton to obtain some essential data on which to base initial studies in Africa.

Liquid Formulations.

51. Small trials in East Africa had indicated that a DDT emulsion (A.T.S.O.) had given better results than solutions or wettable powders against tsetses when applied to plants exposed to ordinary climatic conditions. Preliminary trials with the aircraft at Porton were therefore confined to oil-in-water emulsions containing DDT or BHC. It was estimated that:—

(i) At 77° F. and 65-70 per cent. relative humidity, evaporation of drops emitted at 100-200 ft. was not serious for drops giving mass median diameters of approximately 700 microns. It was therefore considered not necessary to add substances to prevent evaporation, since the most easily available of these—molasses—seriously upset stability of the emulsions.

(ii) Mass-median diameter of drops from 100-200 ft. was of the order of 700 microns. This is higher than had been expected from previous trials with the same equipment, but with a different aircraft.

(iii) Swathe width was about 60 yards.

(iv) Ground recovery (i.e. the amount getting down to the ground) as assessed by jump cards, was about 70 per cent.

52. In East Africa a trial assessment of the BHC emulsion was done in open country. Flying at 130 ft. in bright sun, with an air temperature of 80° F. and relative humidity of 56 per cent., a recovery of 60 per cent. was obtained—slightly less than in England, but still considered quite good. Particle sizes ranged from 100 to 2,400 microns, with a mass-median diameter of 700.

53. *Field Experiments Nos.* 22 *and* 23: Trials were then conducted on two heavily forested islands infested with *G. palpalis*—Kimi, of 177 acres (DDT emulsion) and Tavu, of 113 acres (BHC emulsion). The applications were made from heights between 150 and 350 ft., depending upon climatic conditions and especially wind. Estimated dosage was about 0.25 lb. of insecticide per acre. Recoveries in the open areas on the islands varied between 20 per cent. and 60 per cent., with a mean of 40 per cent., but near the ground under the vegetation, recovery was from 0.4 per cent. to 0.8 per cent It was obvious that by far the greater proportion of insecticide was deposited on vegetation considerably above the normal haunts of tsetses. After six applications at 12 to 14 day intervals there was a small but significant (25 per cent.) reduction of fly on Kimi (DDT) but no reduction on Tavu (BHC). For the last two applications on each island flying height was reduced to treetop or thereabouts, swathe width being thereby reduced to about half, dosage was doubled (i.e. 0.5 lb. per acre) and swathes were alternated with untreated strips of about the same width. In effect, therefore, about half the vegetation on the islands was treated, with four times the previous dosage, but in strips instead of even distribution. This method apparently resulted in a distinct reduction in fly numbers.

Smokes.

54. Preliminary trials were conducted at Porton to test aircraft equipment and to obtain some essential data on the solutions and the smokes produced from them. MgO plates were used for assessments; flying heights were 15-25 ft. Drop sizes ranged from 15 microns to 280 microns, and it was obvious that much of these "smokes" was really fine liquid spray. There was also evidence that some quite large liquid drops were being produced. It was not possible by the methods adopted to account for total output, and it was assumed that an appreciable proportion was lost in the form of very fine particles.

55. In East Africa further assessment trials were conducted. Solutions containing 10 per cent. of DDT and BHC in power kerosene (80 per cent.) and fuel oil (20 per cent.) were used. From these trials it seemed clear that:—

(i) only some 5 per cent. to 10 per cent. of the total output can be recovered by the normal layout of MgO plates, in the form of droplets of 5 to 250 microns, with a mean mass diameter of 70 microns;

(ii) much of the output collected from near the end of the exhaust pipes (with engines hot and running at the maximum possible on the ground) is in the form of liquid, and in this there is a 20 per cent. decomposition of insecticide. This liquid may be due to inadequate volatilisation, the engines generating insufficient heat while running on the ground.

56. *Field Experiments Nos.* 20 *and* 21: The same solutions were used for a series of experimental applications to two heavily forested islands on Lake Victoria—Nfo, of 160 acres, and Sowe, of 280 acres. The aitcraft flew as near treetop height as possible on lines marked by smoke from generators in boats. Meteorological conditions and dosages were recorded at each operation. Dosages measured on plates exposed in open areas ranged from $0\text{-}10^6$ drops per sq. yard, with a majority of $1\text{-}20 \times 10^4$ drops per sq. yard. Under the canopy, variations of dosage were much greater. It seems that within the vegetation the drops as recorded on plates have very little horizontal motion, few being deposited on undersurfaces. If the assumption is correct that an appreciable proportion of the output is in the form of particles of less than

10 microns—and this seems to be so from later observations—probably more smoke is penetrating the canopy and the lower vegetation than was recorded, and in a form that would almost certainly have a toxic effect on active flies. In general, however, it seems that very little of the output is getting below the top canopy, except through gaps. Dosages in the lower vegetation were influenced not only by general and local climatic conditions at the time of operations, but also by variations in output of the aircraft themselves, and in fact of the port and starboard tanks. This latter variation cannot be explained at the moment. After five applications a statistical analysis of the results indicated a drop of about 45 per cent. of tsetses on Nfo island, which was treated with BHC, and about 40 per cent. on Sowe, treated with DDT. In the last three treatments on both islands, dosages were doubled. Reduction of fly for the eight treatments were approximately 63 per cent. for BHC and 46 per cent. for DDT.

Insecticide Barrier Experiment, Tanganyika

57. *Field Experiment No.* 24: This experiment was designed to indicate the effect of a barrier of liquid spray on *G. swynnertoni* (and some *G. pallidipes*). The area selected is traversed by a stock route and it was proposed to treat a belt one mile wide on each side of the stock route, and to observe the effect on fly activity on cattle passing along the route. The first application of 5 per cent. DDT in fuel oil and power kerosene was made in the period 18th-29th, March and the second on 4th-15th April.

Mosquitoes and Malaria

Field Experiments in the Treatment of Native Huts

58. (44) (a) *Kasanji* (*Uganda*). This experiment has been continued and the six treated districts have now received six house applications of insecticides over about 2½ years. There is evidence that the effects of the different treatments are overlapping, and that they are also influencing the control area. Reductions in malaria parasite rates in those districts which have had the same treatment in 6 applications over 2½ years appear to be as follows:—

	Per cent.
5 per cent. BHC in Shell Diesoline	57
5 per cent. BHC Wettable Powder (P530)	44
5 per cent. DDT in Shell Diesoline	27
5 per cent. DDT on roofs only	22
Control district	60 *increase*

Reductions in districts that have received the present treatments since November, 1947, appear to be as follows:—

	Per cent.
5 per cent. DDT Wettable Powder (Guesarol 33) ...	53
5 per cent. DDT W.P. (" Ditrene ")	49
Control district	24 *reduction*

In the treated area as a whole the parasite rate has fallen since early 1946 from 38 per cent. to 20 per cent., and the spleen rate from 52 per cent. to 14 per cent., and a " t " test for the significance of regression co-efficient of the fall of the parasite rate with time gives P = 0.02. Vector mosquito catches are now very low in all districts, including the control, but those in the neighbouring untreated district of Busi are still of the same order as in pre-treatment days.

District.	Vectors per month per 100 houses, 1948.	Vectors per 100 houses per month pre-treatment.
Mumyuka	1.4	740
Musale	0	187
Mutuba II	31	1,444
Mutuba III	0	938
Sabagabo	0.3	487
Sabawali	3.1	137
Sabadu (Control)	5.3	130
Busi	2,040	

The last treatment was applied in December, 1948, and January, 1949.

59. (44) (b) *Jinja, Uganda*: Final observations on mosquitoes and malaria are being made. There has been litle, if any, change in malaria incidence. There is evidence that vector mosquitoes (*A. gambiae* and *A. funestus*) are now slowly increasing in the area that was treated, and that the sporozoite rate of *A. gambiae*, at least, is rising.

60. (c) *Mbale, Uganda*: Mbale is a small town of about 4,000 population, mostly Indians, situated in N.E. Uganda. It has been notoriously malarious for years and was selected because of this. Observations on mosquitoes have been made throughout the past year. Peaks of *A. gambiae* have occurred in July and of *A. funestus* in October, in both the treatment and control areas. Gland infections in the treatment and control areas were 4.2 per cent. and 5.4 per cent. for *A. gambiae*, and 12.8 per cent. and 11.4 per cent. for *A. funestus*. The parasite rates recorded in 360 Indian school children in November, 1948, was 6 per cent. This low rate is attributed by local medical authorities to the wide use of quinine for all ailments. Further bloodslides were taken from Indian and African infants of 5 years and under, but results of their examination are not yet available.

The first spraying of houses with 5 per cent. DDT wettable powder (Guesarol 33) was completed in February, 1949. Houses treated included 27 European, 271 Indian and 705 African, with a total of 2,337 rooms of various sizes. Dosage, as estimated chemically from sample papers, varied from 18 to 644 mgms./sq. ft., with a mean of 112 mgms./sq. ft. for walls; and 24 to 189 mgms./sq. ft. with a mean of 65.5 mgms./sq. ft. for ceilings and roofs.

Mosquito Behaviour in Experimental Huts

61. (45) Studies on mosquito behaviour in huts treated with DDT and BHC formulations are being resumed. New huts have been erected and surrounded by concrete drains to keep out ants. In addition, wood and fibre trap huts are being used. Observations on *A. gambiae* and *A. funestus* have begun.

Disinfestation of Aircraft

62. (20) An experiment is being conducted to ascertain the effects on insects entering aircraft of applications to internal surfaces of various formulations of DDT and BHC. The work is being carried out on behalf of the Committee by a member of the staff of the Senior Parasitologist, Kenya, and with the co-operation of East African Airways. Initial tests were conducted to discover the action, if any, of carbon tetrachloride, the proposed solvent, on metals, leather, cloth and perspex that might be encountered in aircraft. Corrosion was not a problem, but it was found that perspex and patent finishes suffered seriously from the action of the solvent.

For the next tests a Rapide aircraft of East African Airways, employed on regular passenger service, had portions of its interior surfaces sprayed with a carbon tetrachloride base emulsion of DDT at a dosage of 100 mgms. of DDT per sq. ft. A second Rapide was treated similarly with BHC emulsion. Biological tests for toxicity against *Aedes aegypti* were carried out on all treated surfaces every two weeks. Three months after treatments all treated surfaces (DDT and BHC) were lethal in six hours or less to *A. aegypti* exposed to one hour contact.

In February, 1949, the first of a series of monthly observational flights was made from Nairobi to Entebbe in another Rapide that had been sprayed completely inside with the DDT emulsion the day before. Fifty specimens of *A. aegypti* were released in the treated cabin after take-off. After two hours none could be found alive. Only 15 dead specimens, however, were recovered when a full search was made at Entebbe airport. On the return journey another 50 specimens were released before take-off. At Nairobi 27 dead were found. No living specimens could be discovered. More of such flights will be made with improved technique for recovering specimens.

Laboratory Studies—Entomological

Effect on Emerging Flies of Insecticide applied to Soil

63. These observations were made as a preliminary to Field Experiment No. 18, referred to earlier in paragraph 48. DDT at the rates of 500 and 400 mgms./sq. ft. applied to sand and soil respectively containing pupae of *G. palpalis*, caused mortality of 100 per cent in emerging flies over the periods of emergence—24 and 40 days. 400 mgms. of BHC per sq. ft. applied to soil containing pupae caused 80 per cent. mortality of emerging flies over 31 days. No evidence was obtained by the chemist of decomposition of DDT or BHC when added to soil in this way.

Toxicities of Mixtures of BHC and DDT

64. Toxicities of mixtures of BHC and DDT 1:3, 1:1, and 3:1, applied to wood and filter paper, were lower than the toxicities of BHC and DDT used alone.

Loss of Toxicity of BHC

65. BHC in benzene applied to glass plates at 20 mgms./sq. ft. decreased in toxicity (to *G. palpalis*) on exposure. Records of insect mortality and loss of insecticide were as follows:—

(i) *In Laboratory at* 70–80° F.

	Time after application						
Mortality 3 hrs. after 20 secs. exposure.	0	6 hrs. 100 per cent.	24 hrs. 90 per cent.	2 days 80 per cent.	3 days 85 per cent.	5 days 50 per cent.	6 days 30 per cent.
Insecticide remaining in mgms./sq. ft.	19·5	10·4	9·4	7·3	7·8	5·2	2·5

(ii) *After short exposures to sun at mean temperature of* 97° F.

	Time in sun						
Mortality 2 hrs. after 20 secs. exposure.	0	½ hr. 100 per cent.	1 hr. 85 per cent.	1½ hrs. 85 per cent.	2 hrs. 100 per cent.	2½ hrs. 55 per cent.	3 hrs. 55 per cent.
Insecticide remaining in mgms./sq. ft.	18·7	12·3	8·8	8·3	9·5	7·2	5·3

Toxicity of Chlordane

66. Preliminary tests with Chlordane indicated that it is approximately as toxic to *G. palpalis* as DDT, but because of its greater volatility its persistence is less.

Effect of Aerosols on Anaesthetised Tsetses

67. In tests with aerosols against anaesthetised tsetses it was found that 1.2 micrograms of DNOC per fly gave 40 per cent. kill; 0.02 micrograms of DDT per fly gave 100 per cent. kill; and 0.008 micrograms of BHC per fly gave 100 per cent. kill.

Laboratory Studies—Chemical

68. Most of the time of the department has been occupied with the very many estimations required in connection with the field experiments at Kasanji, Mbale and on the islands of Lake Victoria.

Decomposition in Smokes

69. Some time has been spent in estimating the amount of decomposition in smokes from aircraft exhausts. Decomposition may amount to 20 per cent. or more in smokes and liquids collected from exhausts on the ground. This may well be greatly exceeded when the exhaust pipes become more heated during flight.

Colorimetric Estimation of Small Deposits of DDT and BHC on Vegetation

70. Attempts have been made to apply several of the published colorimetric methods for estimating the very small amounts of DDT and BHC deposited on vegetation and sampling plates treated from the air, but so far without success.

Differential Settling Out of Wettable Powders

71. Examination of the quickly settling sludge deposits left behind in sprayers used for the application of DDT wettable powder in the field has confirmed previous work that this sludge is almost entirely technical DDT. There is considerable evidence indicating that powders undergo a sorting out of particle sizes, or differential settling out, between the dates of mixing and use (assuming that mixing is adequate). In one barrel of DDT wettable powder, for instance, the percentage of DDT varied from 33 per cent. at the top to 49.4 per cent. at the bottom of the barrel. This difference in insecticide content could obviously lead to very unsatisfactory and very misleading results, and probably does. Further observations are being made on this subject.

Thermal Decomposition of Mixtures of DDT and BHC

72. A repetition of Gunther's work (J. Econ. Entom, 1947, *40*, 875) on the thermal decomposition of mixtures of technical or pure DDT and technical BHC or a pure BHC isomer, is being carried out. Results so far obtained indicate that samples of BHC isomers purified solely by one or two crystallisations did not, as was claimed, readily cause catalytic decomposition of pp' DDT at 110° C. The inorganic benzene-insoluble residues from technical BHC preparations were found to have a strong catalytic effect on the thermal decomposition of para para DDT at temperatures as low as 90° C. Work on this subject is continuing.

Estimation of Chlordane

73. An attempt is being made to find a satisfactory method of estimation of chlordane.

Analysis of BHC

74. Work is proceeding with the object of devising a fairly simple method for determining the percentage of gamma isomer in technical preparations of BHC, but so far with no promising results. Many solubilities of BHC isomers in various solvents have been determined in the course of this work.

Simulium and Onchocerciasis

75. (30) The proposed large hydro-electric scheme on the Nile near Jinja has made further investigation of this problem necessary. Mr. Wilkinson, Entomologist, who was stationed at Jinja in 1948, has started preliminary work and some of his findings are as follows:—

(i) Among adult *Simulium* fed on 17 Africans, those from 13 showed microfilariae in the blood meal. Some Africans infected all flies that were fed on them. Only 3 of these men were skin-snipped; all were positive.

(ii) Pupae of *S. damnosum* were found:—

(*a*) at Ripon Falls, high up where there was apparently little extra aeration;

(*b*) at Owen Falls—not only in the classical sites but on trailing grass in slow-moving waters;

(*c*) Mbulamuti—on trailing vegetation.

(iii) Repellents to adults—Dimethyl phthalate and three American repellents were tested. Dimethyl phthalate gave the best results.

(iv) The use of insecticides against adults is being explored.

Malaria eradication experiment—Mauritius

76. This is an experiment in the elimination of malaria, in the first instance by the application of residual insecticide formulations to vector-mosquito feeding and harbouring places, followed if necessary by treatment of breeding places and other measures. The intention is to study the effect on mosquitoes and malaria of one control measure at a time. Mauritius has an area of about 700 sq. miles and a population of about 420,000, of whom 265,000 are Indians. A small scientific team of one malariologist (in charge), one chemist and one entomologist, together with six field officers, was appointed in the United Kingdom and junior staff were appointed in Mauritius. The malariologist and entomologist received a month's preliminary training at the London School of Hygiene and Tropical Medicine and then, with the chemist, spent a further month with the Colonial Insecticides Research Unit, in East Africa. The whole team arrived in Mauritius in the second week of November, 1948. Some two months were devoted to appointing the field and laboratory staff and organising their work, and in preliminary surveys of mosquitoes, spleens and parasites. These activities were hindered somewhat by delays in the arrival of equipment and stores.

For the purpose of the experiment the island is divided into six districts (A, B, C, D, E and F) each under the control of a field officer, who has an assistant field officer and a staff of 10 overseers, 36 spraying operators and transport. The three senior scientists, with a labour supervisor and junior laboratory and office staff, are stationed at Headquarters, where there are offices, laboratories and living accommodation. For the first phase of the work districts A and B are being treated with 5 per cent. DDT in kerosene solution, district C with 5 per cent. BHC wettable powder and districts D, E and F with 5 per cent. DDT wettable powder. It is hoped that early results in these three areas will indicate the superiority of one or other of

these formulations for future use over the whole of the island. The first application of insecticide to dwellings, cattle and goat sheds and other harbourages started on January 17th, 1949. All the most malarious areas were treated by the end of March. Spraying equipment consisted of Four Oaks "Kent" Knapsack sprayers, but extensive trials are being made in towns of the "Aerostyle" and Lister motor driven sprayers. The reaction of the population is excellent.

Malariology

77. Average parasite and spleen rates before spraying were as follows:—

District	No. of children examined	Spleen Rate	Parasite Rate
A	600	4·3	2·3
B	621	17	6
C	606	53·6	15
D	603	54	13
E	599	46·7	8·8
F	574	41·4	10·4

Low parasite rates are probably a reflection of the season. There were very few mosquitoes about in December and January, except in one or two places, and infection was probably very low. Malaria usually increases in February and reaches its peak in April or May. Records are being kept of malaria in infants born after the start of spraying and of hospital malaria morbidity and mortality figures. The French authorities in Réunion have consented to the collection of malaria parasite and spleen rates in Réunion as a control for the Mauritius experiment.

Entomology

78. Routine collections of mosquitoes brought down by "flitting" in 576 selected representative houses in each district are made monthly. In addition, once every three months a whole week is to be devoted to a large-scale flitting of houses in each district, to supplement the figures obtained by the routine collections. The two sets of figures together should be sufficient to indicate an absence of mosquitoes later, if this occurs. The initial flittings were probably not very thorough because of the inexperience of staff and inadequate equipment, but they improved from about the end of January. Mosquitoes so far recorded in routine catches in January and February are as follows:—

District	No. of houses searched	Anopheles per house	Culicines per house
A	176	0·02	30·1
B	140	8·9	28·7
C	505	3·2	22·6
D	1,149	2·6	5·1
E	690	0·7	9
F	390	12	15·3

The highest anopheline catch was 314 (mostly *A. funestus*) recorded in 3 hours in district F. "Mass" flitting undertaken in all districts from February 14th, 1949 to February 18th, 1949, inclusive, produced the following figures for mosquitoes in houses:—

District	No. of house catches	No. of Anophelines collected (gambiae and funestus)	No. of Culicines collected
A	593	25	8,417
B	676	203	2,562
C	415	2,530	4,385
D	481	13,629	2,169
E	308	71	2,240
F	276	1,009	4,261

Chemistry

79. A close check is being kept on the spraying, by large numbers of routine estimations of deposits on sample surfaces exposed on walls during spraying, and of deposits on wallpaper. In the earliest days of the work, when operators were completely unskilled, deposits varied enormously from 0 to 900 mgms. per sq. ft. More recently estimations have shown much less variation. For instance, samples from 12 gangs in one district ranged from 65 to 218 mgms. per sq. ft., with an average of 138 mgms. per sq. ft. The aim is to obtain a deposit of 100 mgms. per sq. ft. at this stage. Persistence of the insecticidal deposits is also being recorded by periodical estimations of samples applied in houses at the time of the spraying. It has been found that with the wettable powders now available, variations of deposits result not only from poor technique in application but from a quick settling out in sprayers of portions of the powder in suspension. With some powders this differential settling is so marked that only continuous and very vigorous agitation prevents concentration of insecticide, though not necessarily of diluent, in the lower layers of the suspension.

Swaziland—Visit of the Officer-in-Charge of Research

80. A second visit was made in February, 1949, to see and discuss progress on tsetse and malaria control measures suggested during the first visit in 1948.

Tsetse

81. *G. austeni.* Clearings of about 400 yards designed to break the continuity of infested bush in ravines are being completed along the watershed in the north-eastern border areas. Harris traps have been set up in the ravines on the western slopes to indicate the presence or absence of *austeni.* At present it is intended to do no more than keep a close watch for a possible spread of this fly.

82. (61) *G. pallidipes.* The large clearing on the north and west of the infested area has been completed, except for clearing up of re-growth in some places, but the trees left in portions of the clearing would appear to provide ample cover for patrolling flies, though perhaps not for breeding. Flies have been reduced to very small numbers in the infested areas as a whole; no specimens have been caught in the Harris traps for some weeks. This seems to be the result of the 18 DDT smoke applications by the South African Air Force. Recently six pairs of bait cattle have been patrolling the area. They have attracted a few flies. BHC insecticidal smoke generators have been sent to Swaziland. The veterinary authorities intend to use them in an experimental attempt to deal with the few flies left in ravine thickets and evergreen bush.

An additional anti-tsetse measure being applied in Swaziland is the dipping of cattle weekly in an emulsion of DDT and arsenic. According to the views of the Onderstepoort Veterinary Research authorities, this is toxic not only to ticks but it also kills tsetses settling on cattle.

Malaria

83. (62) The small field experiments designed by Dr. Mastbaum, Malariologist, to test the influence on malaria of house spraying with (i) DDT (5 per cent.) wettable powder, (ii) BHC (5 per cent.) wettable powder, and (iii) DDT Emulsion M.35 (ex Klipfontein), are under way. The areas selected are on the middle and low veldt. Each has about 700 native houses and a population of about 2,000. Spraying was done once only in December, 1948. The rains were late and consequently there are few mosquitoes.

They may now increase as the result of the rains in late January and early February. But it is possible that the insecticides applied nearly two months previously may not have very marked effect. Parasite rates in samples of 200 children taken before the applications and since, in the treated areas and an untreated control, show no apparent change. It is very probable that the prolonged drought and lateness of the mosquito and malarial season may help to produce results that are inconclusive.

Helicopter Spraying Experiments

84. The objects of the work carried out to date under the Sprayers' Sub-Committee of the Inter-Departmental Co-ordinating Committee, at the Chemical Defence Experimental Station, Porton, have been threefold. Firstly, to develop a technique for the physical assessment of the spray produced by a helicopter, secondly to assess the performance of the Bell 47/3B Helicopter syraying equipment, and thirdly to explore the slipstream from the rotor blades with a view to determining the optimum position for the spray bar. Forty-four spray assessments trials have been performed in wind speeds ranging from 0 to 20 m.p.h. In these trials the aircraft speed has been varied from 6 to 30 m.p.h. and the flying height from 5 to 50 ft. From the results of the trials the following tentative conclusions may be drawn:—

(1) The technique used initially to assess the physical performance of the spray produced—a technique designed to reduce the number of sampling points and thus keep the laborious laboratory work down to an absolute minimum—has proved unsatisfactory and a modified form of the standard method is now being employed.

(2) The Bell spraying equipment, as received, gives a deposit on the ground which is many times too large when related to the requirement of 0.25 lb. of active agent per acre. Reduction in the number of nozzles from 44 to 14 effects an improvement in the density of the deposit.

(3) The swath width (the breadth of the swath in which a deposit of not less than 0.25 lb./acre of active agent is obtained) produced by the Bell spraying equipment is about 14 yards for "cross" wind spraying, and slightly more for "into" wind spraying.

(4) The swath produced is not uniform and an undesirable "peak" in the middle of the swath is evident.

(5) The mass median diameter of the drops produced is about 200 μ at 30 yards downwind and 500 μ in the line of flight.

(6) The percentage recovery of the charging on the ground is about 60.

(7) The mechanical performance of the Bell spraying equipment, as fitted, is satisfactory.

(8) There is no significant difference between the spray produced by a spray bar fitted forward of the pilot's cabin and that fitted behind the pilot's cabin.

(9) The skill of the pilot is probably the most important factor in helicopter spraying.

Future work will be directed towards the following points:—

(*a*) Eradication of the undesirable "peak" in the deposit swath.

(*b*) Determination of the performance of improved nozzles (Teejet).

(*c*) Determination of the characteristics of the sprays produced by oil solutions, water emulsions and suspensions.

Control of Froghopper in Trinidad

85. Earlier reference has been made in this Report (para. 21) to a series of experiments conducted by Messrs. Caroni Ltd. with a Bell Helicopter in Trinidad as a means of disseminating insecticides against froghopper (*Tomaspis saccharina*) on sugarcane. The main findings of the experiments were as follows:—

(*a*) Dust containing 5 per cent. DDT applied in the late afternoon or evening at the rate of 30 lb. per acre gave excellent initial kills of adults (90-100 per cent.) but the population rose rapidly and after 3 to 6 days had reached the control level, showing that there was little or no residual effect from the insecticide.

(*b*) Dust applied in the morning proved ineffective. The probable reason for this was that while the dust gave good coverage of the foliage it did not penetrate sufficiently far into the leaf funnels where the insects were resting. Furthermore, the down draught of the helicopter rotor, although it shook the cane violently, was not sufficient to cause the dormant froghoppers to take wing. By the late afternoon, when the froghoppers were active, the heavy daily showers common during this period of the year had washed away most of the insecticide. On the other hand, late afternoon and evening dustings were effective because they coincided with the maximum activity of the adult froghopper and there was no time for the insecticide to be washed away.

(*c*) The diluent used in the insecticide dust had a marked effect on its activity. The order of efficacy of the diluents used being local ground limestone, fuller's earth and china clay.

(*d*) Rates of application of dust below 30 lbs. per acre gave patchy kills resembling those caused by dusting under gusty wind conditions.

(*e*) Increasing the weight of DDT or BHC per acre had in general little effect. With BHC, however, a fourfold increase did show a slight effect on nymphs, but the effect was far less than that of an equal amount applied to the stools directly by means of a hand gun.

(*f*) Helicopter dusting is fatiguing work for the pilot and two to three hours continuous flying is as much as he can reasonably be expected to do. As the dusting operation has to be confined to the late afternoon and evening, only two to three hundred acres can be dealt with by one machine in a day. If dusting has to be carried out every six days to prevent population build up, one machine will be kept fully occupied treating 1,000 to 1,500 acres. As froghopper attack may occur over 10,000 acres even in a light year, the number of helicopters combined with the frequency of dusting make the use of helicopters, at least by this method, an uneconomic one.

(*g*) It was hoped that residual insecticide effect might be obtained by the use of oil-base sprays. Only a few tests had been carried out before the helicopter unfortunately met with an accident and the experiments were abandoned. It was found, however, that oils which had been applied the year before by means of the Todd Insecticidal Fog Applicator (see Report 1947-48, para. 27) without any deleterious effect on cane foliage proved phytotoxic

when put out by helicopter, due, possibly, to too large droplet size. There should, however, be no difficulty in finding a suitable oil and experiments with oil sprays should be carried out as soon as possible. These could in the first instance be done with ground equipment.

(*h*) It is clear that a great deal of research is still required on the design of dusting and spraying equipment for aircraft.

APPENDIX

List of Publications

Papers Published

Commonwealth Air-route Sanitation: a Suggestion. By C. B. Symes. *Journal of the Royal Sanitary Institute,* 1948, *68,* No. 5, 539-544.

Synthetic Insecticides in Colonial Development. By C. B. Symes. *Journal of the Royal Society of Arts,* 1948, *96,* 641-656.

Synthetic Insecticides and Malaria. By C. B. Symes. *Revue Agricole de l'Ile Maurice,* 1948, *27,* 113-121.

Malaria Control in British Guiana. By H. J. Holman. *Corona,* 1949, *1,* No. 4, 14-16.

Tests of Insecticides on Cattle. By P. R. Wilkinson, *East African Agricultural Journal,* 1948, *14,* 12-17.

Papers in the Press

Surface Insecticidal Deposits on Mud. By A. B. Hadaway and F. Barlow. *Bulletin of Entomological Research*

Applications of DDT to Vegetation. By A. B. Hadaway and F. Barlow. *Bulletin of Entomological Research.*

The Effect of Sunlight on the Residual Properties of DDT. By A. B. Hadaway and F. Barlow. *Bulletin of Entomological Research.*

Toxicity to *Glossina palpalis* and *Aedes aegypti* of DDT on a Non-absorbent Surface. By A. B. Hadaway. *Bulletin of Entomological Research.*

Observations on Mosquito Behaviour in Huts. By A. B. Hadaway. *Bulletin of Entomological Research.*

Observations on Mosquitoes in Unoccupied Treated Huts. By A. B. Hadaway. *Bulletin of Entomological Research.*

Reports Circulated in Mimeographed Form

Progress Report No. 1, Colonial Insecticides Research Team, Porton.

Progress Report No. 5, Colonial Insecticides Research Unit, Uganda.

Annual Report No. 6, Colonial Insecticide Research Unit, Uganda.

Preliminary Report on the Mauritius Malaria Eradication Scheme.

Field Trials with DDT and Gammexane against Tsetse (*G. palpalis*): Applications to Cloth Screens. By K. S. Hocking, A. B. Hadaway and K. E. Woodcock.

Persistence of DDT Formulations when applied to Vegetation. By the Colonial Insecticides Research Unit, Uganda.

Report on a Visit to Cyprus to observe the Anopheline Eradication Work, July, 1948. By J. R. Busvine.

Anopheles Eradication in Sardinia. Report on a Working Visit in 1948. By C. Garrett-Jones.

Colonial Economic Research Committee Second Annual Report (1948-1949)

London School of Economics and Political Science,
Houghton Street,
Aldwych, W.C.2.
29th April, 1949.

SIR,

I have the honour on behalf of the Colonial Economic Research Committee to transmit to you the second report of the Committee covering the period from 1st April, 1948 to 31st March, 1949.

I have the honour to be,
Sir,
Your most obedient servant,
(Sgd.) ARNOLD PLANT.

The Right Honourable A. Creech Jones, M.P.,
Secretary of State for the Colonies.

COLONIAL ECONOMIC RESEARCH COMMITTEE

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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.

MISS P. M. DEANE, Secretary.

Terms of Reference

The terms of reference of the Committee are to advise the Secretary of State in connection with economic research and statistics.

COLONIAL ECONOMIC RESEARCH COMMITTEE

CONTENTS

SECOND ANNUAL REPORT

I. INTRODUCTORY

1. During the year 1st April, 1948, to 31st March, 1949, the Committee held three meetings.

2. Mr. H. Leak has resigned from the Committee on relinquishing his appointment as Head of the Statistics Division, Board of Trade. He has been replaced by Mr. J. Stafford, his successor in that office, who had previously served on the Committee in place of Mr. H. Campion when the latter was in the United States. Mr. K. E. Robinson, Reader in Colonial Administration at Oxford University, has been appointed a member of the Committee. Mr. Paul Wilson resigned as Secretary of the Committee and was replaced by Miss P. Deane.

3. During the year an Advisory Panel on National Income Studies was set up to assist the Committee in considering the question of national income research. The Panel comprises Professor Sir Arnold Plant (Chairman), Professor Brown, Professor Frankel and Mr. 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.

II. THE PLANNING OF ECONOMIC RESEARCH

4. In the first annual report of the Colonial Economic Research Committee (Cmd. 7493) reference was made to the formation of a new Department within the Colonial Office which would carry out economic research. The new Department (now called Economic General Department) has attached to it three research officers and two assistant research officers. The Secretary of the Committee is a member of the Department.

5. The Committee have been concerned in the year under review with advising the Colonial Office on technical economic problems arising in connection with the appreciation of economic conditions in Colonial territories. They have also collaborated with the Colonial Office in preparing a comprehensive programme of colonial economic research to be undertaken as and when qualified research workers become available. The programme will represent the joint views of the Committee, the Colonial Governments and the Colonial Office and it is hoped that it will serve to attract research workers and to encourage them to undertake studies for which there is the greatest need.

III. RESEARCH PROJECTS

6. Two research studies which were undertaken by Colonial Research Fellows and supervised by the Colonial Economic Research Committee are now in process of being prepared for publication. They are Miss P. Deane's enquiry into *National Income, Production and Expenditure in Northern Rhodesia and Nyasaland;* and Miss P. Ady's Study of the *Occupational Structure of Representative Communities in the Gold Coast as influenced by wartime Government expenditure;* Dr. C. Leubuscher's series of studies on *Factors affecting the location of industries processing Colonial primary products* is continuing and two reports—one on cocoa and one on oil seeds—were published during the year in the *Bulletin* of the Imperial Institute; a report on sisal is in the press and reports on sugar and timber are being prepared for publication.

A Study of Colonial Monetary Systems was initiated during the year and this is being carried out by Dr. I. Greaves.

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.

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